Nuclear Energy Canada Inc.

Annual Compliance Monitoring Report

January 1 to December 31

2020

The information contained in this report concerns the performance and operation of BWXT Nuclear Energy Canada Inc.'s (BWXT NEC) Class IB nuclear facilities located in Toronto and Peterborough, Ontario. This report is prepared to meet fuel fabrication operating licence FFOL-3620.01/2020 condition 2.4. The content demonstrates adherence to the BWXT NEC commitment to operate safe Class IB nuclear facilities, as well as demonstrate compliance with applicable regulations and licence conditions specified by the Canadian Nuclear Safety Commission.

Peterborough & Toronto

Revision	Description	Prepared by Date	Approved by Date
00	Initial Issue	S. Rheubottom 2021-03-30	D. Snopek 2021-03-30

Signing Authority Contact Information:

David Snopek, Director, EHS & Regulatory

1160 Monaghan Road

Peterborough, ON K9J 0A8

Phone number: 1-855-696-9588

Email: questions@bwxt.com

Submitted to:

J. Amalraj, CNSC Project Officer on 2021-03-31

1 EXECUTIVE SUMMARY

BWXT Nuclear Energy Canada Inc. (BWXT NEC) has been involved with the Canada Deuterium Uranium (CANDU®) industry from its earliest years. BWXT NEC produces nuclear fuel bundles used by the CANDU fleet to generate clean electricity that powers homes, business and the Canadian economy. BWXT NEC operates in three plant locations: Arnprior, Toronto and Peterborough, Ontario. BWXT NEC's Toronto and Peterborough facilities are Class IB nuclear facility operations. The operating licence issued by the Canadian Nuclear Safety Commission (CNSC) authorizes BWXT NEC to operate and modify its nuclear fuel facilities to produce natural and depleted uranium dioxide (UO_2) pellets in Toronto at 1025 Lansdowne Ave., and produce and test fuel bundles in Peterborough at 1160 Monaghan Rd. The Peterborough facility is additionally authorized to receive, repair, modify and return contaminated equipment from off-site nuclear facilities.

The purpose of this compliance report is to demonstrate that BWXT NEC has successfully met the requirements of the Nuclear Safety and Control Act, associated regulations and the Class IB Nuclear Fuel Facility Operating Licence FFOL-3620.01/2020 revised by the CNSC on December 16, 2016, and expired on December 31, 2020. This report is prepared based on the CNSC's *Annual Compliance Monitoring and Operational Performance Reporting Requirements for Class I A & B Nuclear Facilities* and regulatory document 3.1.2 *Reporting Requirements, Volume I: Non-Power Reactor Class 1 Nuclear Facilities and Uranium Mines and Mills*. Appendices containing confidential, proprietary and prescribed information are submitted to the CNSC separately.

BWXT NEC is committed to continuously improve systems to protect employees, the environment and our communities against environmental, health and safety hazards. We work to implement programs and objectives to conserve natural resources, prevent pollution and minimize waste. Maintaining a safe and healthy work environment for our employees is a top business priority. BWXT has implemented a business management system that defines the requirements of the Quality Assurance (QA) program for the licensed activity, which ensures applicable buildings and facilities, process equipment, and processes used in support of licensed activities are conducted in accordance with the Nuclear Safety Control Act, associated regulations, applicable CNSC requirements, jurisdictional requirements and compliance best practices.

No significant operational changes occurred at either facility. Upgrades were made to programs with the objective of achieving continuous improvement and environmental health and safety excellence. Details are provided in the main sections of this report. Changes made to the physical facilities, equipment, processes, procedures or practices that could impact employee health and safety, the environment or the public as a result of the operation of the facilities are assessed through the business-wide Change Control program.

BWXT NEC has established facility specific CNSC approved A*ction Levels* for various radiological and environmental parameters. An Action Level is defined in the Radiation Protection Regulations "as specific dose of radiation or other parameter that, if reached, may indicate a loss of control of part of a licensee's radiation protection program, and triggers a requirement for specific action to be taken." Action Levels are also applied to environmental protection. Action Levels are facility-specific and set below regulatory limits; however, they are CNSC reportable events. Accordingly, BWXT NEC has established *Internal Control Levels* for various radiological and environmental parameters that are set even lower than Action Levels to act as an early warning system. Internal Control Level exceedances result in internal investigation and correction and are not CNSC reportable events.

Employee workplace radiation exposures are measured by CNSC approved methods and systems. Overall, dose trends are favourable and consistent with an effective application of the ALARA (As Low as Reasonably Achievable - Social and Economic Factors considered) principle. All measured radiation exposures received by personnel in the reporting period were within regulatory limits and Action Levels.

BWXT NEC has established conventional health and safety programs to manage the non-radiological workplace safety hazards to protect personnel. Key performance indicators are used to measure the

success of the programs throughout the year. Both sites had zero lost time injuries during the reporting period.

BWXT NEC recognizes that an effective way of maintaining public trust is to maintain environmental excellence. This requires a demonstrated commitment to operating in accordance with the highest environment, health and safety standards. The facilities maintain effective environmental management systems to achieve environmental goals and objectives and keep all environmental impacts well within applicable standards and as low as reasonably achievable. These programs demonstrate compliance to relevant provincial and federal legislation. Environmental protection programs are also compliant with the following standards:

- Canadian Standards Associate (CSA) N288.6-12, *Environmental risk assessments at Class I nuclear facilities and uranium mines and mills*
- CSA N288.5-11, *Effluent monitoring programs at Class I nuclear facilities and uranium mines and mills*
- CSA N288.4-10, *Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills*,

Air and water emissions are routinely measured from both facilities to demonstrate compliance with the CNSC's environmental protection requirements and the ALARA principle. Annual releases were a very small fraction of regulatory limits and all measurements were below Action Levels. Soil samples were taken surrounding the Peterborough and Toronto plant with all measurements within applicable guidelines.

Established emergency response plans are in place that describe the actions to be taken to minimize health, safety and environmental hazards to workers and local members of the public, which may result from fires, explosions, or the release of hazardous materials. The plans intend to reduce the risk of emergencies such as fires, and assist emergency staff and plant personnel in understanding key emergency response issues. The plans assist the facilities in protecting employees, the local community and the environment through sound emergency management practices. The emergency response plans were developed in accordance with CNSC operating licence requirements with significant improvements made to Peterborough's plan during the reporting period, including designated Emergency Operations Centre locations. Peterborough Fire Services participated in joint emergency exercises through the year, including a successful CNSC witnessed exercise.

BWXT NEC has implemented and maintains a safeguards program and undertakes all required measures to ensure safeguards implementation in accordance with International Atomic Energy Agency (IAEA) commitments and CNSC regulatory document 2.13.1 *Safeguards and Nuclear Material Accountancy.* Movement (inventory changes) of natural and depleted uranium are documented and reported to the CNSC as required. The IAEA and the CNSC jointly conduct annual verifications.

BWXT NEC safely transports dangerous goods, including Class 7 radioactive material shipments as governed by the *Transportation of Dangerous Goods* Act and Regulations and the Packaging and Transport of Nuclear Substances Regulations. Shipments occur routinely between suppliers and the Toronto and Peterborough facilities, customers and waste vendors.

BWXT NEC places great importance on its relationships with all levels of local government and residents in the communities in which it operates and works to ensure there is open communication and awareness of BWXT NEC's operating activities. The public information program defines the process for providing information about BWXT NEC operations. Public interest in both facilities was high during the reporting period. Enquiries were tracked and responded to as timely as possible. A Community Liaison Committee (CLC) was established in 2020 for Peterborough. The CLCs, whose mandates are to provide a forum for a

cross-section of neighbours and other community stakeholders to share information and ideas, continued to meet regularly.

This compliance monitoring report demonstrates that BWXT NEC has successfully met the requirements of the Nuclear Safety and Control Act, associated regulations and CNSC Class IB Nuclear Fuel Facility Operating Licence conditions.

TABLE OF CONTENTS

FIGURES

TABLES

2 INTRODUCTION

The purpose of this compliance monitoring report is to demonstrate that BWXT NEC has successfully met the requirements of the Nuclear Safety and Control Act, associated regulations and the Class IB Nuclear Fuel Facility Operating Licence FFOL-3620.01/2020 revised by the Canadian Nuclear Safety Commission (CNSC) on December 16, 2016, and expired December 31, 2020. This report is prepared based on the CNSC's *Annual Compliance Monitoring and Operational Performance Reporting Requirements for Class I A & B Nuclear Facilities* and regulatory document 3.1.2 *Reporting Requirements, Volume I: Non-Power Reactor Class 1 Nuclear Facilities and Uranium Mines and Mills*. Appendices containing confidential and proprietary information are submitted to the CNSC separately.

BWXT Nuclear Energy Canada Inc. (BWXT NEC) has been involved with the Canada Deuterium Uranium (CANDU®) industry from its earliest years. BWXT NEC produces nuclear fuel bundles used by the CANDU fleet to generate clean electricity that powers homes, business and the Canadian economy. BWXT NEC operates in three plant locations: Arnprior, Toronto and Peterborough, Ontario. BWXT NEC's Toronto and Peterborough facilities are Class IB nuclear facility operations. Nuclear substance use is regulated federally by the Nuclear Safety and Control Act and associated regulations through the CNSC.

In November 2018, BWXT NEC submitted an application to the CNSC seeking a 10-year renewal of the licence. The CNSC's licensing process for Class 1 facilities is thorough and transparent, including engaging stakeholders through a variety of consultation processes, information sharing, participant funding and communications. CNSC staff conducted technical assessments of the information submitted by BWXT NEC to determine if it meets the relevant regulatory requirements, expectations, international and domestic standards and applicable international obligations. The CNSC's assessment includes input from other federal and provincial government departments, including those responsible for regulating health and safety, environmental protection, emergency preparedness and the transportation of dangerous goods. Following the review, CNSC staff will make recommendations on the licence application to the Commission. A licensing hearing was held in early 2020 to take into account the views, concerns and opinions of interested parties and intervenors. The hearings were open to the public and webcast live. The Commission considers the entirety of an application and all information received in the course of the matter before making a decision.

On December 21st, 2020, the CNSC announced through a news release, its decision to renew BWXT NEC's nuclear fuel facility licence in Toronto and Peterborough. The Commission also decided to authorize the commercial production of fuel pellets at BWXT's Peterborough facility, but not at both facilities at the same time. BWXT NEC's current licence was split into two, one at each location expiring on December 31, 2030. The current CNSC operating licenses authorize BWXT NEC to operate and modify its nuclear fuel facilities. At 1025 Lansdowne Avenue, Toronto (Figure 1), BWXT NEC is authorized for the production of fuel pellets from natural and depleted uranium dioxide. At 1160 Monaghan Road, Peterborough (Figure 2), BWXT NEC is authorized to produce fuel pellets from natural and depleted uranium dioxide, produce and test fuel bundles. The Peterborough facility is additionally authorized to process contaminated equipment from off-site nuclear facilities.

The Toronto facility is located in a mixed industrial, commercial, and residential area in west-central Toronto (Figure 1). The facility consists of two separate buildings, which are identified as Building 7 and Building 9.

Building 7 houses uranium dioxide pellet manufacturing on the first, second and third floors and office space on the fourth floor. Building 9 is a warehouse used for the storage of uranium dioxide as miscellaneous scrap awaiting reprocessing or shipment for disposal, compaction of waste, and decontamination activities.

Figure 1: BWXT NEC Toronto

The Peterborough facility is located in a mixed industrial, commercial, and residential area in west-central Peterborough (Figure 2). The buildings are located on the existing General Electric (GE) plant complex. The licensed facility consists of four buildings; Building 21, 24, 26 and 28, which are leased from GE. Building 21 is a two-floor building and houses the uranium fuel bundle manufacturing operation on the first floor and office personnel on the second floor. Building 24 is a one floor warehouse used to store radioactive material including completed uranium fuel bundles, sealed drums of Uranium Dioxide powder, and contaminated equipment as required. Building 26 is principally a conventional fabrication and assembly operation. It also houses manufacturing equipment and facilities for the repair of contaminated equipment. Building 28 houses the main shipping and receiving docks for Building 26. It is directly accessible through Building 26.

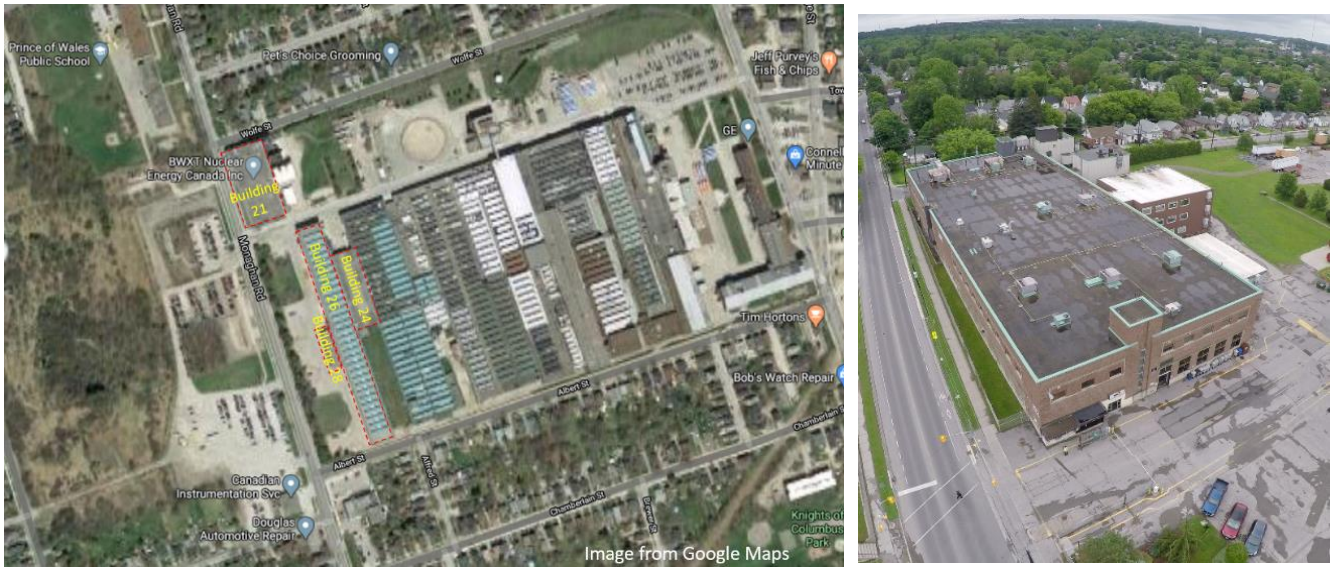

Figure 2: BWXT NEC Peterborough

2.1 Processes and Materials

The Toronto facility processes natural and depleted UO_2 powder into fuel pellets. Specifically, UO_2 powder is received in standard steel drums and the powder is compressed into "slugs" and granulated to a free-flowing powder. This powder is pressed into a pellet shape and the sintered pellets are ground to the required diameter, inspected and wrapped for shipment to the Peterborough facility. BWXT NEC also can periodically ship natural uranium pellets to the United States of America for use in Boiling Water (BWR) commercial power reactors. See Figure 3 for the process.

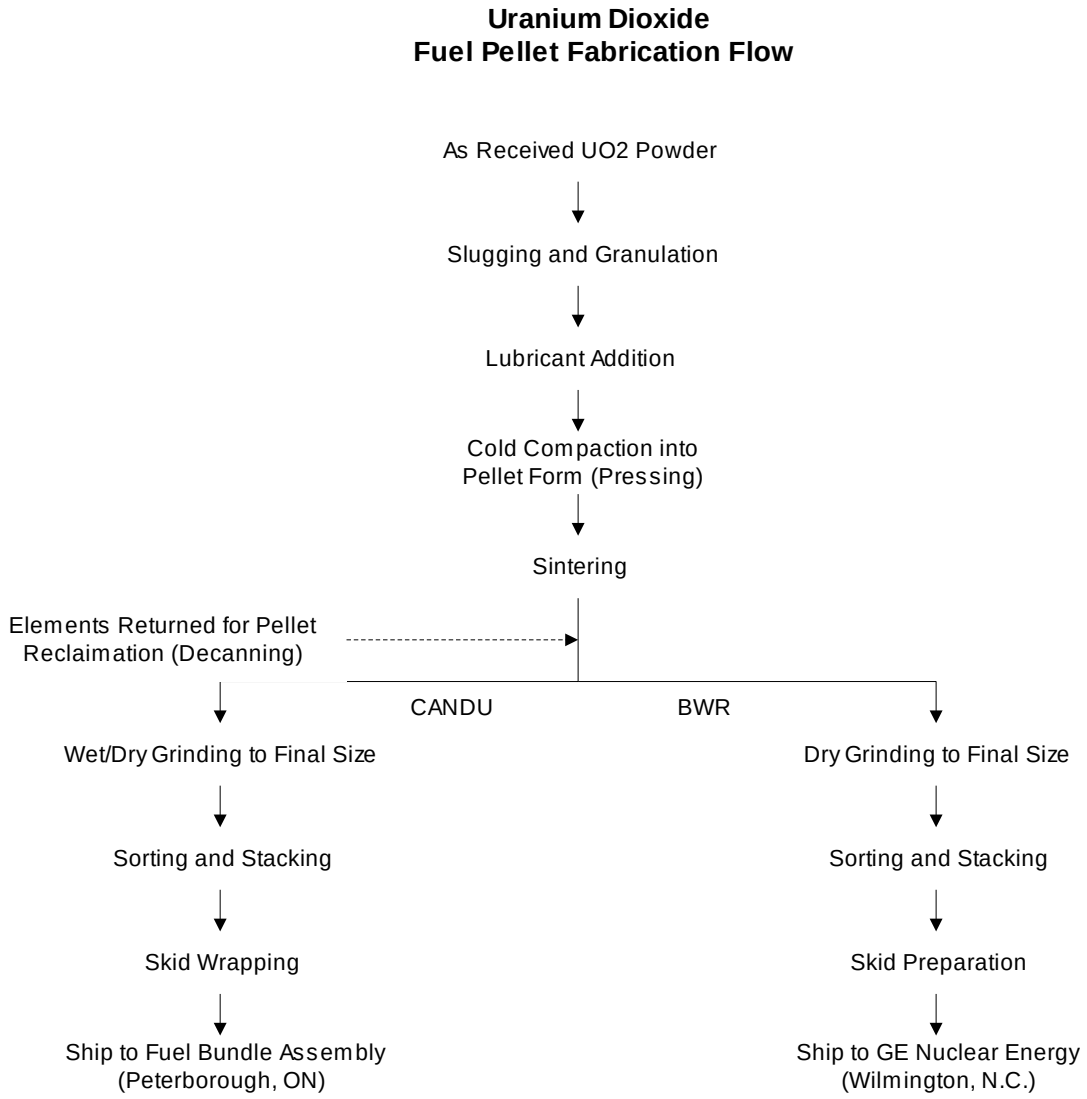

Figure 3: Uranium Fuel Pellet Manufacturing Process

At the Peterborough facility, fuel manufacturing operations involve the loading of fuel pellets into Zircaloy tubes, sealing, and welding of the tubes to produce fuel elements and the assembly of the fuel elements into fuel bundles. The basic assembly process is described in Figure 4.

In addition, contaminated equipment from off-site nuclear facilities may be periodically received at the Peterborough facility for repair and/or modification. No contaminated equipment was received in the reporting period.

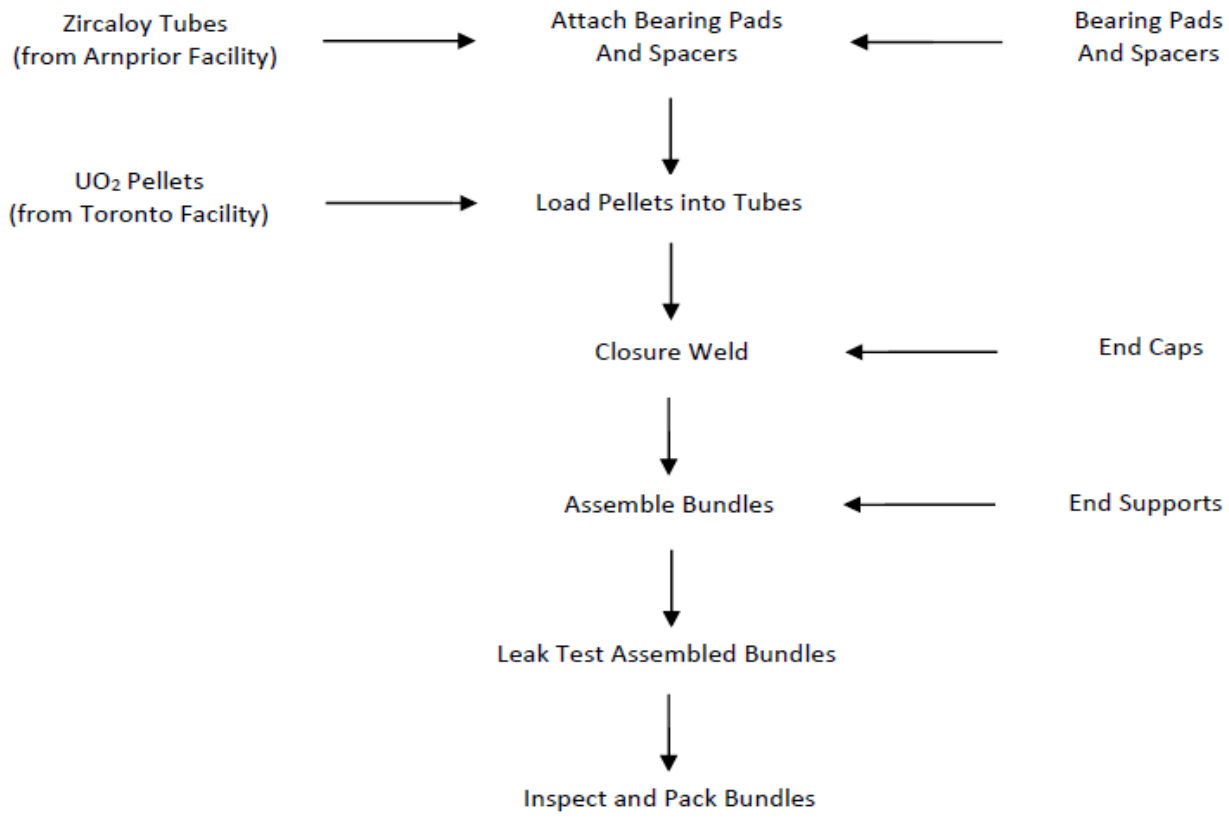

Figure 4: Fuel Bundle Fabrication Process

BWXT NEC is federally regulated for health and safety. The federal health and safety legislation is the Canada Labour Code Part II and the Canada Occupational Health and Safety Regulations. The Canada Labour Code is enforced by Employment and Social Development Canada. The purpose of Part II of the *Canada Labour Code* is to prevent accidents and injury to health arising out of, linked with or occurring in the course of employment. BWXT NEC facilities are also regulated federally by Transport Canada. BWXT NEC is additionally regulated environmentally through municipal Sewer Use Bylaws and provincially by the Ontario Ministry of the Environment, Conservation and Parks (MECP).

BWXT NEC is committed to the establishment and continuous improvement of a healthy safety culture. Safety culture refers to the core values and behaviours resulting from a collective commitment by our company's leaders and individuals to emphasize safety, quality, ethics, and security over competing goals to

ensure protection of people and the environment. The Environment, Health and Safety (EHS) Mission Statement defines it as a top business priority to continuously improve our EHS systems to protect fellow employees, the environment, and our communities against known and potential environmental, health and safety hazards. The BWXT NEC management team reviews, prioritizes and controls workplace hazards and ensures compliance with the pertinent regulatory requirements, applicable codes and company policies.

The primary facility potential radiological hazard from uranium is the inhalation of airborne UO_2 particles. Measurements are performed for airborne and surface traces of uranium as an indicator of process containment efficiency. Urine samples provided by employees are used to indicate if inhalation may have occurred. A lesser potential radiological hazard exists in the form of low-level external gamma and beta radiation exposure to employees. Whole body, skin and extremity dose measurements are conducted to demonstrate compliance with the dose limits specified in the Radiation Protection Regulations and the ALARA principle. All dose measurement results for employees were below regulatory limits and Action Levels.

Air and water emissions are routinely measured to demonstrate regulatory compliance and the ALARA principle. Annual releases were a small fraction of regulatory limits and all measurements were below Action Levels.

Table 1 defines the acronyms used in this report.

Acronym	Definition
ALARA	As Low as Reasonably Achievable (social and economic factors considered)
ATS	Action Tracking System
BWXT NEC	BWXT Nuclear Energy Canada Inc.
CANDU	CANadian Deuterium Uranium
CCAB	Canadian Council of Aboriginal Business
CCME	Canadian Council of Ministers of the Environment
CLC	Community Liaison Committee
CNSC	Canadian Nuclear Safety Commission
CSA	Canadian Standards Association
CTS	Critical-to-Safety
dpm	Disintegrations per minute - unit of measure for radioactivity 1 dpm = 0.017 disintegrations per second/Becquerel
EHS	Environment, Health and Safety
FHA	Fire Hazards Analysis
IAEA	International Atomic Energy Agency
MECP	Ministry of the Environment, Conservation and Parks
MP	Member of Parliament
MPP	Member of Provincial Parliament
mSv	milliSievert – unit of measure for radiation dose 1 mSv = 0.001 Sv = 1,000 µSv

Acronym	Definition
NEW	Nuclear Energy Worker
PAR	Progressive Aboriginal Relations
PDP	Preliminary Decommissioning Plan
POI	Point of impingement
ppm	Parts per million
QA	Quality Assurance
SSC	Systems, structures and components
TEDE	Total Effective Dose Equivalent
TLD	Thermoluminescent Dosimeter
UO_2	Uranium Dioxide
µSv	microSievert – unit of measure for radiation dose 1 µSv = 0.001 mSv = 0.000001 Sv
WSC	Workplace Safety Committee

Table 1: Definition of Acronyms

3 SAFETY AND CONTROL AREAS

3.1 Operating Performance

The "Operating Performance" Safety and Control Area covers an overall review of the operations licensed activities.

BWXT NEC has successfully implemented and maintained over the course of the licence period, a program for the operation of its Toronto and Peterborough facilities, which provides direction for safe operation and reflects the Facility Safety Analysis. BWXT NEC has established essential documentation (as specified by the Business Management System) including procedures describing the program or system process and work instructions outlining the steps required to complete an individual or set of tasks. This includes the written work instructions for handling of radioactive materials by workers to ensure activities are conducted in a manner that is protective of workers, the public and the environment; as well as full and accurate records to show the acquisition of nuclear substances, inventory of all radioactive nuclear substances and the disposition of all nuclear substances acquired for use or processed by BWXT NEC.

Over the reporting period, BWXT NEC continued to operate in a manner that supports the company mission to continuously improve EHS systems to protect fellow employees, the environment, and communities against known and potential environmental, health and safety hazards. Operating performance is monitored with key performance indicators and program goals. Reporting of EHS-related concerns is encouraged through a rewards program. These are assigned and tracked to completion in the Gensuite® software system and is used as a measure of employee engagement. In accordance with EHS program requirements, internal audits and self-assessments are conducted routinely to assess conformance to internal and external requirements. Due to company travel restrictions, all self-assessments and audits were conducted remotely/virtually. Related licensed activity audits and self-assessments are summarized in subsequent sections.

The BWXT NEC management team continued to review, prioritize and control workplace hazards and ensure compliance with the pertinent regulatory requirements, applicable codes and company policies. With the declaration of the pandemic in early 2020 and BWXT NEC's inclusion as an essential business, production activities continued throughout the year with new safety policies and programs instituted in accordance with relevant provincial regulations and public health requirements. For example, where possible, employees were directed to work from home and continue to do so in order to limit gatherings; additional cleaning staff and protocols were instituted for all high touch points; employee screening was instituted, and all employee travel has been limited to essential only.

Facility operations continued routinely and safely. Challenges were introduced with the declaration of the pandemic including contractor availability and supply chain difficulties. Despite these challenges, UO_2 pellets were shipped to BWXT NEC's Peterborough facility without incident. The pellets were assembled into CANDU reactor fuel bundles and were then safely shipped to customers. Plant personnel followed procedures satisfactorily, as reflected in internal and external audits, self-assessments, radiation surveys, contamination monitoring, air sampling measurements and other safety inspections. Details are provided in subsequent sections of this report. There were Action Level exceedances at the Toronto plant with respect to the pH of water effluent to the sanitary sewer system. These releases were within the parameters defined in the relevant sewer by-law. There were no other Action Level exceedances or unplanned events at either facility over the reporting period.

During the reporting period, the R2 area in Peterborough was modified and automatic production equipment for the sorting and stacking of fuel pellets was added. There were no significant modifications made to the Toronto facility.

The President of BWXT NEC is responsible for all activities within the company. The various functional groups, such as Human Resources, EHS, Quality and Communications report directly or indirectly to the President. Senior Management accountability for the effectiveness of the management systems is defined. The Director, EHS & Regulatory is responsible for the overall EHS program.

The following key position changes occurred:

- In September 2020, the Production Manager in Toronto left the business and the responsibilities were temporarily managed by the Production Supervisor until the Production Manager position was filled in November.

During the reporting period, there were no pertinent modifications to the company organization structure. The company senior management organization structure is shown in Figure 5.

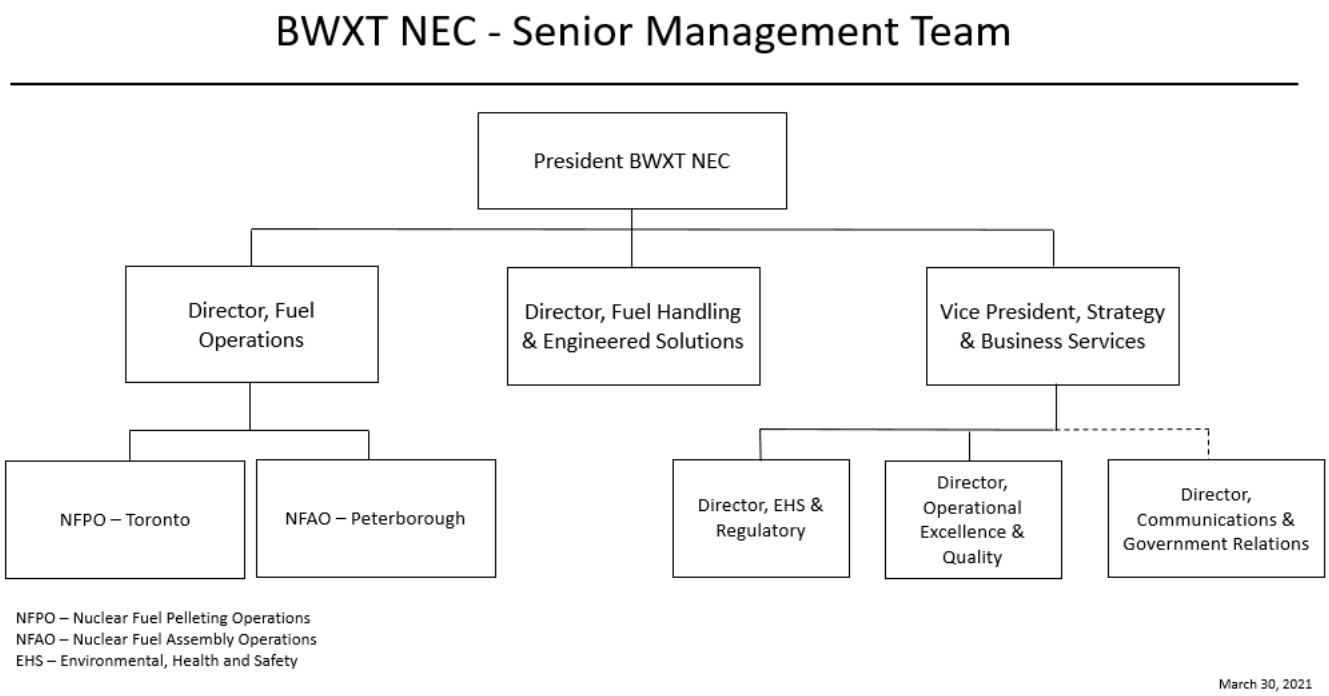

Figure 5: BWXT NEC Organization Structure

BWXT NEC maintains five EHS related committees that review activities including proposed changes to ensure safe plant operations. They are:

- Health and Safety Policy Committee - comprised of unionized workers and management to contribute to making the company as safe as possible by promoting health and safety awareness, making recommendations to workers and management regarding policies and procedures for safe working practices
- Workplace Safety Committee (WSC) - comprised of unionized workers and management to prevent accidents and occupational illness by promoting health and safety awareness, making recommendations to workers and management regarding safe work practices and monitoring health and safety issues until resolved
- As Low as Reasonably Achievable (ALARA) Committee - comprised of unionized workers and management to continuously improve the radiation safety program and implement ALARA practices where practical to ensure that radiation doses are as low as reasonably achievable.
- Beryllium Safety Committee – comprised of unionized workers and management to continuously improve the beryllium safety program and reduce potential beryllium hazards to workers at the Peterborough site.
- Ergonomics Committee - comprised of unionized workers and management to develop, monitor and administer the ergonomic procedure and recognize, reduce and where possible eliminate physical and cognitive ergonomic risk factors.

3.1.1 Possession and Processing

All possession and monthly processing limits, as specified in the CNSC facility operating licence were met. Production data is proprietary and is provided separately to the CNSC in Appendix A.

Production shutdowns were scheduled periodically throughout the year for engineering projects, equipment maintenance and continuous improvements. In the reporting period, there were six weeks of production shutdown in Peterborough including one week in the first quarter, three weeks in the third quarter and two weeks in the fourth quarter. In Toronto, there were five weeks of production shutdown, including three weeks in the third quarter and two weeks in the fourth quarter.

3.1.2 Regulatory Inspections

Excluding safeguards related inspections, which are described in section 3.13 of this report, the CNSC completed two routine inspections at both Toronto and Peterborough sites.

1. An inspection was completed to provide an overall assessment of BWXT NEC's Public Information Program. Two non-compliances were identified relating to its Community Liaison Committees, its communication strategy and products. Two recommendations were also identified. One non-compliance has been corrected, while program improvements to address the remaining non-compliance and recommendations continue into 2021.

2. An inspection was focused on import and export controls under the Nuclear Safety and Control Act and Nuclear Non-proliferation Import and Export Control Regulations, and the licenses issued. One non-compliance was identified and corrected shortly after the inspection. Two recommendations for improvement were also noted. Program improvements to address the recommendations continues into 2021.

Additionally, at the Peterborough facility:

1. An inspection was completed with a focus on site security and compliance with the Nuclear Security Regulations. Four non-compliances, one Action Notice and four recommendations were identified. Actions associated with the non-compliances have been completed. One Action Notice remains open and is in progress.

2. An inspection was focused on witnessing a full-scale emergency exercise under the Emergency Preparedness and Fire Protection Safety and Control Area. No non-compliances and one recommendation was issued. Continuous improvements to the program are ongoing.

Additionally, at the Toronto facility:

1. Transport Canada remotely assessed compliance with the Transportation of Dangerous Goods Act and associated regulations. Two non-compliances were identified related to shipping documentation. Documentation improvements were made to address the non-compliances, which were submitted and deemed acceptable by Transport Canada.

2. Technical Standards and Safety Authority assessed compliance with the Technical Standard and Safety Act with an inspection of the site’s elevating devices. Two inspection orders were issued and addressed.

All corrective and preventive actions related to Action Notices/Non-compliances are submitted to the regulator if required and tracked to closure.

3.2 Management System

The "Management System" Safety and Control Area covers the framework which establishes the processes and programs required to ensure that the organization achieves its safety objectives and continuously monitors its performance against these objectives, as well as fostering a healthy safety culture.

The management system defines the requirements of the QA program for the licensed activity, which ensures applicable buildings and facilities, process equipment, and processes used in support of licensed activities, are conducted in accordance with the Nuclear Safety Control Act and associated regulations, applicable CNSC requirements, jurisdictional requirements and compliance best practices. A graded approach is used in the application of the management system program elements, such that the requirements are applied in a manner commensurate with the safety significance of the licensed activity, system, component or structure. The management system is comprised of the following core program elements:

1. Organization and Responsibilities
2. Personnel Capability
3. Use of Experience
4. Work Planning Control
5. Work Processes Control
6. Verification
7. Problem Identification and Resolution
8. Corrective Action
9. Change Control
10. Document Control and Records
11. Audits
12. Management Self-Assessment
13. Management Program Review
14. Supply Chain

The President of BWXT NEC is responsible for all activities within BWXT NEC. Operations and the various functional groups, such as Human Resources, Environment Health and Safety, and Quality Assurance, report directly or indirectly to the President.

Senior Management accountability for the effectiveness of the management systems has also been defined. For example, the Director, Operational Excellence and Quality has been assigned the responsibility for monitoring and assessing the effectiveness of the business licensed activity management system and is responsible for identifying problems, initiating or recommending solutions, and confirming their implementation and effectiveness. The company senior management organization structure is shown in Figure 5.

The management system is fully implemented and compliant with CSA N286-12, *Management System Requirements for Nuclear Facilities*. All management system documentation required by operating licence condition 2.1 is in place. The EHS Policy establishes the direction for the management system. Continuous improvement is achieved through several review processes, including self-assessments, audits, and management reviews. There were no major changes to the management system or responsibilities during the reporting period.

BWXT corporate policy describes BWXT's commitments to the establishment and continuous improvement of a safety culture. The safety culture refers to the core values and behaviors resulting from a collective commitment by BWXT NEC leaders and individuals to emphasize safety, quality, ethics and security over competing goals to ensure protection of people and the environment.

BWXT NEC is committed to maintaining a strong safety culture and clearly states the expected safety culture behavior. For example, the promotion of a standard set of human error reduction tools for job-site workers and knowledge workers, which include 1) Procedure Use and Adherence 2) Questioning Attitude 3) Situational Awareness and 4) Self-Checking. BWXT NEC's commitment to a strong safety culture is measured by tools such as employee concerns, incident investigations, audits and self-assessments, use of experience and corrective action program metrics which measure the effects of safety culture improvements. External agencies such as the CNSC audit BWXT NEC operations against CSA standards which include safety culture requirements (e.g., CSA N286-12).

In the reporting period, minor continuous improvements were made to the following programs:

- Operating Experience and Use of Experience

Where required, revised documents were submitted to CNSC staff in accordance with the requirements in the licence conditions handbook.

3.2.1 Licensed Activity Related Self-Assessments

The Self-Assessment program governs a proactive process for self-critical, candid and objective evaluation of performance by a functional area measuring their process performance against internal procedures, expectations, goals established from business plans or external benchmarking standards. The Self-Assessment Program is a management tool used to engage the workforce in early and proactive detection of organizational or systematic weaknesses. It is a Functional Manager's opportunity to take a structured look at their own function. Self-Assessments help identify low level issues or trends for early resolution before more significant problems occur.

A Self-Assessment schedule is prepared annually and ensures that each program element is reviewed periodically based on a risk-related approach. A summary of self-assessments conducted in the reporting period is provided in Table 2. The majority of identified non-conformances were related to improvements in documentation accuracy and compliance, and record keeping. All identified non-conformances are assigned and tracked to closure. There were no systemic deficiencies identified.

In addition to the Self-Assessment program, routine compliance reviews are periodically completed against regulatory EHS requirements, such as general environmental, water management, safety management and emergency response. Due to challenges with the software program used, no regulatory compliance reviews were completed during the reporting period. The software issues have since been resolved and the reviews are scheduled for 2021.

	Program Element	Number of Non-Conformances
Peterborough	Training	1
	Document and Record Control	3
	Radiation Protection	0
	Work Planning, Control & Verification	4
	Fire Protection	1

Program Element		Number of Non-Conformances
	Use of Experience and Operating Experience	3
	Non-Conformance and Corrective Actions	4
	Respiratory Protection Program	1
Toronto	Environmental Management	3
	Training	1 (duplicate from Peterborough)
	Document and Record Control	2
	Work Planning, Control & Verification	1
	Radiation Protection	4
	Emergency Preparedness	4
	Respiratory Protection Program	4
	Non-Conformance and Corrective Actions	4
	Calibration of Critical-to-Safety Measuring and Test Equipment	1
	Total	40

Table 2: Summary of Self-Assessments

3.2.2 Licensed Activity Internal Audits

Internal auditing is an independent, objective activity designed to add value and continuously improve programs. Periodic assessment of program effectiveness is conducted through systematic internal audits that are planned and carried out on behalf of management to measure performance, the effectiveness of the program element processes and to promote continuous improvement. An audit schedule is prepared annually and ensures that each licensed activity program element is audited at least once every three years.

Table 3 provides a summary of internal audits conducted in the reporting period. Audits were conducted remotely due to the pandemic and company travel restrictions, which presented some limitations. The identified non-conformances were related to the accuracy and detail in documentation and implementation of practices. All identified non-conformances are assigned and tracked to closure.

In addition, a review of all the findings is conducted as part of the management review to determine if any systemic deficiencies have been identified. Based on the review, continuous improvement opportunities are discussed and documented in the meeting minutes with actions tracked to closure.

	Audit Scope	Number of Non-Conformances
Peterborough	Audits	0
	Environmental Management System (ISO-14001:2015)	0
	Environmental Protection (Water)	0
	Radiation Protection (General Practices & Decontamination)	0
Toronto	Audits	0
	Change Control	0
	Environmental Management System (ISO-14001:2015)	2
	Environmental Protection (Water)	0
	Radiation Protection (General Practices & Decontamination)	1
	Use of Experience (including Operating Experience)	0
	Total	3

Table 3: Summary of Internal Audits

BWXT NEC did not conduct any formal external audits of other facilities during the review period that related to the licensed activities at the facility.

3.2.3 Management Reviews

Management reviews for EHS program elements are conducted once annually before the end of April each year to review the previous calendar year activities. The EHS management reviews encompass the following items:

- Status and follow-up of actions from previous management reviews;
- Results of applicable external agency audits;
- Open regulatory compliance obligations;
- Results of “Reg Auditor” (Gensuite) compliance evaluations;
- Results of QA for licensed activity internal and external audits (where applicable);
- Results of QA for licensed activity management self-assessments;
- Trends in non-conformances (Gensuite Action Tracking System items) for closure metrics;
- EHS related QA Actions;
- Trends in Incident and Measurement (Gensuite) items for root cause;
- Status of EHS training activities;
- Procurement process;
- Extent to which Environmental, Health and Safety and ALARA objectives and targets have been met;

- Radiation dose trends;
- Communications and changes in the needs and expectations of interested parties, including complaints;
- Changing external and internal issues, including compliance obligations;
- Changes in risks and opportunities;
- Opportunities for continual improvement;
- Evaluation of the effectiveness and continuing suitability of the EHS Mission Statement and the Environment, Health and Safety Program, which includes the EHS management system and hazard prevention program.

The above inputs are reviewed to ensure continuing suitability, adequacy and effectiveness of the management system. The criteria for these are:

- **Suitable**: Does the system satisfy the requirements and represent the best way of doing things for our business?
- **Adequate:** Is the system fit for its current purpose?
- **Effective:** Does the system enable the right things to be done? Is it driving continuous improvement?

Formal meeting minutes are prepared. The previous management review meeting resulted in three actions that were formally issued for follow-up by the applicable functional lead(s), and were tracked to closure in the Action Tracking System (ATS). One resulted in an additional review of the impact of the pandemic of business goals and management system requirements, such as self-assessments and audits. The second resulted in some wording modifications to the EHS Mission Statement. The third was to establish targets for ATS closure rates and overdue items. No systemic deficiencies were noted. Overall, the implemented management system for the licensed activity program was considered suitable, adequate and effectively implemented at both facilities. Continuous improvement remains a priority.

3.3 Human Performance Management

The "Human Performance Management" Safety and Control Area covers activities that enable effective human performance, through the development and implementation of processes that ensure that BWXT NEC staff members are sufficient in numbers in all relevant job areas, and have the necessary knowledge, skills and tools in place to safely carry out their duties.

The training program is outlined in the Licensed Activity QA Manual, and business-wide training procedures. Qualifications and training requirements are identified and personnel are given the appropriate training to ensure they are competent at the work they do. This training includes on-the-job training, radiation protection and safety risk assessment training. Workers only perform functions for which they are qualified. Both facilities achieved 100% regulatory training completion in the reporting period. Compliance to regulatory training completion is a key performance indicator that is tracked throughout the year. Key EHS course completion details are provided in Table 4.

Course Name	Number of Peterborough Employees Who Required Course (% Required Completed)	Number of Toronto Employees Who Required Course (% Required Completed)
Aerial Lift Practical	5 (100%)	4 (100%)
Aerial Lifts	7 (100%)	4 (100%)
Change Area Contamination Control	N/A	7 (100%)
Compressed Gas Safety	26 (100%)	10 (100%)
Electrical Safety 2.0 – Canada	174 (100%)	35 (100%)
Emergency and Disaster Preparedness – Canada	199 (100%)	40 (100%)
Emergency Response & Fire Prevention Awareness	N/A	46 (100%)
Fall Protection Advanced	10 (100%)	0
First Aid (Emergency Response Team)	0	9 (100%)
Indoor Hoisting and Rigging – Canada	12 (100%)	2 (100%)
Lockout Tagout (LOTO) Procedure	21 (100%)	18 (100%)
Lockout/Tagout 2.0 – Canada	192 (100%)	40 (100%)
Lockout Tagout (LOTO) Try-Out Demonstration	24 (100%)	13 (100%)
Manufacturing Area Hazards Awareness (includes Radiation and Beryllium Safety)	122 (100%)	N/A
Overhead Cranes Level 1 & Practical	4 (100%)	N/A
Portable Fire Extinguisher Training (Practical)	13 Exempt (see note below)	N/A
Portable Fire Extinguishers – Canada	348 (100%)	51 (100%)
Powered Industrial Truck - Driving Evaluation	N/A	1 (100%)
Powered Industrial Truck Safety with Propane Handling	11 (100%)	3 (100%)
Radiation Safety	N/A	8 (100%)
Respirator Selection Use and Care	0	3 (100%)
Respiratory Protection 2.0 - Canada	29 (100%)	9 (100%)
Security Awareness	32 (100%)	38 (100%)
Transportation of Dangerous Goods	8 (100%)	3 (100%)
Workplace Hazardous Materials Information System (WHMIS)	52 (100%)	9 (100%)

Course Name	Number of Peterborough Employees Who Required Course (% Required Completed)	Number of Toronto Employees Who Required Course (% Required Completed)
Workplace Hazardous Materials Information System (WHMIS) 2015	31 (100%)	11 (100%)

Table 4: Key Training Course Completion Summary

Note: Portable Fire Extinguisher Training (Practical) is provided by Peterborough Fire Services and was postponed due to COVID concerns and precautions. The target audience for this training is trained annually on portable fire extinguisher theory and have had practical training in years past. The training is anticipated to be completed in 2021.

During the reporting period there were several opportunities to simplify and improve training across both the Peterborough and Toronto sites. Examples of these include:

- Workplace Hazardous Materials Information System course content was updated, and all 1988 content was replaced.
- Security Awareness training was updated and split into two separate courses to allow for customization for each site.
- Manufacturing Area Hazards Awareness and EHS Specialist Training were updated to include training on asbestos.
- Facilities Coordinator training was updated with respect to Hot Work Permits.

Other new courses implemented during the reporting period included Security Guard Work Instruction Review training, Radiation Instrumentation training, and Emergency Response training.

The facilities are staffed with a sufficient number of qualified workers as well as the minimum number of responsible people to carry on the licensed activities safely and in accordance with the Nuclear Safety and Control Act and associated regulations. EHS and other staff are available after business hours as needed through cell phones and paging devices.

3.4 Safety Analysis

The "Safety Analysis" Safety and Control Area covers the maintenance of the safety analysis which supports the overall safety case for the facility. The safety analysis is a systematic evaluation of the potential hazards associated with the conduct of an activity or facility, and considers the effectiveness of preventive measures and strategies in reducing the effects of such hazards. The safety analyses utilize a combination of What-if Analysis, Hazards and Operability and Quantitative Risk Analysis and documents a systematic evaluation of hazards associated with the licensed facilities.

Modifications to the facilities are made in accordance with the business-wide Change Control program, which requires review of EHS parameters for new or modified facilities, processes, and new or relocated machinery, apparatus and equipment. Under this process, a proposed modification is screened for potential impact on the facility safety analysis. Where screening identifies a potential impact, a more detailed review of the proposed modification is conducted to identify if the change impacts a safety system, or the basis of the safety assessment (e.g. materials, quantities, locations, etc.). Third-party reviews or regulatory approvals are conducted as required. In this way, impacts on the safety analysis are identified and the safety analysis is validated and updated, where necessary.

During the reporting period, an update of the safety analysis for the Peterborough site was completed to reflect the addition of the sort and stack operation. An update of the Toronto facility safety assessment was also completed to reflect changes in material inventories and locations. The safety analysis reports for both sites conclude that the engineered and administrative controls provide protection over a broad range of operating conditions that both restricts the likelihood of events and adequately protects the public and environment.

3.5 Physical Design

The "Physical Design" Safety and Control Area relates to activities that impact on the ability of systems, structures and components (SSC) to meet and maintain their design basis, given new information arising over time and taking into account changes in the external environment.

Changes made to the physical facilities, equipment, processes, procedures or practices that could adversely affect product quality, employee health and safety, the environment or the public as a result of the operation of BWXT NEC's facilities are assessed through the Change Control program. Any changes to the design basis are identified and assessed by key stakeholders through this program, including third-party reviews as required. Adequate mitigations are applied including modification of the proposed change, up to rejection of the proposed change.

During the reporting period, there were no modifications to the physical plants that altered the design basis. During the reporting period an automated pellet sort & stack operation was installed at the Peterborough facility. This operation arranges the pellets into their final stack length for insertion into the fuel element. As part of that change the decan exhaust system was replaced with a new exhaust system to service this operation which also provides a workstation for pellet decanning. The safety analyses for the facilities were updated during the period to reflect these changes.

3.6 Fitness for Service

The "Fitness for Service" Safety and Control Area covers activities that impact on the physical condition of SSCs to ensure that they remain effective over time. This includes programs that ensure all equipment is available to perform its intended function when called upon to do so.

A Critical to Safety (CTS) program is in place. CTS items are those hardware items that directly ensure the safety of workers, protection of the environment, or regulatory compliance in the following three categories:

- Equipment and infrastructure identified as Safeguard Measures in the Facility Safety Analysis reports;
- Respiratory personal protective equipment; and
- Instrumentation generating data to demonstrate Regulatory Compliance.

BWXT NEC documentation describes the CTS program for the production of nuclear fuel, including CTS items common to both business units, Fuel Manufacturing and Fuel Handling and Engineered Solutions. Equipment identified on the CTS list is governed by a number of assurance procedures.

The CTS program elements include the following:

- Process to identify CTS equipment;
- CTS inventory list revision control;
- Procurement controls governing ordering and incoming verification to confirm CTS equipment received matches the CTS equipment list requirements;

- Requirements in the established change management program to adequately capture new additions and ensure sufficient detailed review of changes to existing CTS equipment; and
- The factors determining the preventive maintenance schedule of CTS Equipment.

Both facilities are using an asset management and preventive maintenance software system. Maintenance Connection® is a web-based maintenance management software for work order and asset management. Maintenance Connection assists BWXT NEC in efficiently managing preventive maintenance tasks as well as to control and identify maintenance on CTS and Critical-to-Quality assets and components. Preventive maintenance tasks on CTS equipment are designated in this system as described in the business wide Enterprise Asset Management Program Procedure.

Certain CTS tasks have associated immediate independent post-maintenance verification or testing. For example, independent verification is in place on the ventilation systems during filter changes as well as following Toronto rotoclone ductwork maintenance.

In both Toronto and Peterborough, 99% of CTS tasks issued were completed within 14 days of the target completion date. All CTS tasks issued in the reporting period are closed.

Preventive maintenance is considered during the assessment of changes as part of the business-wide Change Control program. Additionally, in the event of a near miss, incident, injury, inspection or suggestion, the preventive maintenance program for related equipment is reviewed as applicable. As a result, during the reporting period, the following improvements to preventive maintenance tasks were implemented:

- The lock-out tag-out statement for the cleaning of the graphite coater was updated for clarity (Peterborough)
- A verification task was created for the beryllium ventilation system (Peterborough)
- The inspecting frequency for powder press ventilation hoses was increased to daily (Toronto)
- The inspection task for the bipel tumbler was updated to include verifying that all bolts are secure (Toronto)
- A new task was implemented to inspect brick and slab carts (Toronto)

Managing aging means ensuring the availability of required safety functions throughout the service life of the plant, with account taken for changes that occur with time and use. Aging management applies to SSCs that can, directly or indirectly, have an adverse effect on the safe operation of the plant. The asset management program accounts for aging through the CTS program inspection, testing and maintenance tasks. These processes provide warning signs and initiate corrective and preventive maintenance activities. Items identified for replacement are assessed through the Change Control program.

The preventive maintenance program is periodically assessed through self-assessments and internal audits, discussed in section 3.2 of this report. Key performance indicators are in place and are routinely reviewed. The program is adequate and effective and is continually improved.

3.7 Radiation Protection

The "Radiation Protection" Safety and Control Area covers the implementation of the radiation protection program, in accordance with the Radiation Protection Regulations. BWXT NEC has a well-established and effectively implemented radiation protection program, which includes a commitment to ALARA and continuous improvement. The program addresses the radiation hazards associated with UO_2. This program ensures that surface/airborne contamination and radiation doses to employees and the public are monitored and controlled. The Director, EHS & Regulatory, has oversight of BWXT NEC's radiation protection program.

Internal radiation hazards exist at both the Toronto and Peterborough facilities in the form of loose uranium which may enter the body by inhalation, ingestion or absorption. As a result, continuous and/or periodic air monitoring is conducted at various work stations within the facilities as appropriate. Workstation air monitoring is a key performance indicator that speaks to effective administrative and engineered controls. A respiratory protection program is in place in accordance with Canadian Standards Associate (CSA) Z94.4-18, *Selection, use, and care of respirators.* Additionally, surface contamination measurements (swipes) are conducted in manufacturing areas of each facility to monitor and reduce the amount of loose radioactive material available for potential internal exposure of employees. As these monitoring processes produce large quantities of data, trending of data is performed at least annually and reviewed by the ALARA committees.

Additionally, urine samples are regularly provided by employees to indicate if inhalation may have occurred. Sampling frequency ranges from weekly to once per three months, based on established criteria such as job function and worker location within the facilities. Criteria which determine the frequency of urine sampling for an employee are documented in the radiation protection program.

A lesser potential hazard exists in the form of low-level external gamma and beta radiation doses to employees. Routine gamma surveys are conducted and Nuclear Energy Workers (NEWs) are issued thermoluminescent dosimeters (TLDs) to measure whole body, skin and extremity dose to ensure compliance with the regulatory radiation dose limits and the ALARA principle. Dose results are reviewed by EHS staff on receipt from the licensed dosimetry service provider. In addition, the ALARA Committee reviews trending data from radiation monitoring results through routinely scheduled meetings and provides recommendations to improve ALARA implementation.

As external radiation hazards from the storage and use of radioactive materials may result in radiation doses to workers, routine gamma radiation surveys are conducted within the Toronto and Peterborough facilities using real-time portable handheld radiation detectors. Measured dose rates are compared to established dose rate targets for a given area based on area classification and occupancy. When necessary, items are moved to alternative storage locations and/or shielded. Areas that appear routinely higher than target dose rates are investigated for permanent improvements, such as shielding or reconfiguration.

A component of the radiation protection program is area classification. Areas of each facility are classified into five different categories for the purpose of controlling the spread of radioactive contamination, and ensuring appropriate engineered and administrative controls are in place. These classifications are defined in the Radiation Protection Manual as follows:

- Unclassified Area - these areas do not involve nuclear substances and are considered public domain. Incidental contamination does not exceed the unclassified area Internal Control Levels.
- Active Area - these areas are designed for handling materials with loose contamination that is potentially above unclassified area Internal Control Levels. External radiation hazards are not of significant concern.

- R1 Area - these areas are designed for operations where only external radiation is of concern, and loose contamination is below R1 area Internal Control Levels.
- R2 Area - these areas are designed for operations involving exposed non-dispersible nuclear substances, where external radiation is of concern and loose contamination may be above R1 Internal Control Levels.
- R3 Areas - these areas are designed for operations involving exposed solid dispersible nuclear substances, where external radiation may be of concern and where the hazard of contaminant inhalation or ingestion is identified. Loose contamination may be above R2 Internal Control Levels and below R3 Internal Control Levels. Where the inhalation hazard is high, respiratory protection is required for all area entries.

BWXT NEC has established facility specific CNSC accepted Action Levels for various radiological and environmental parameters. An Action Level is defined in the Radiation Protection Regulations as "a specific dose of radiation or other parameter that, if reached, may indicate a loss of control of part of a licensee's radiation protection program, and triggers a requirement for specific action to be taken." Action Levels are set below regulatory limits; however, they are CNSC reportable events. Action Levels are established in accordance with the CNSC regulatory document G-228, *Developing and Using Action Levels*, which are approved by the CNSC and specified in the licence conditions handbook (refer to Table 5 and Table 6 below). Although Action Levels are set below regulatory limits, exceeding an Action Level is considered a CNSC reportable event in which BWXT NEC must notify the Commission within 24 hours of becoming aware that an Action Level has been exceeded. Accordingly, BWXT NEC has established Internal Control Levels for various radiological and environmental parameters that are set even lower than Action Levels to act as an early warning system. An Internal Control Level exceedance results in internal investigation and corrective and preventive action. During the reporting period, all measurements were below Action Levels and regulatory limits.

Nuclear Energy Worker	Period	Action Level (mSv)
Effective dose	Quarter of a year	4.0
Effective dose	1 year	12.0
Effective dose	5 years	60.0
Skin dose	1 year	100
Extremity dose	1 year	200
Pregnant NEW	Balance of the pregnancy	3.5
Parameter		**Action Level**
Urinalysis		10 µg/L for any period

Nuclear Substance and Form	Action Level		
U in Airborne Contamination	Unclassified Area	R1 Area	R2 Area
	12 dpm/m^3	12 dpm/m^3	36 dpm/m^3

Table 5: Summary of Action Levels for the Radiation Protection Program at Peterborough Facility

Nuclear Energy Worker	Period	Action Level (mSv)
Effective dose	Quarter of a year	6.0
Effective dose	1 year	15.0
Effective dose	5 years	60.0
Skin dose	1 year	350
Extremity dose	1 year	350
Pregnant NEW	Balance of the pregnancy	3.5
Parameter		**Action Level**
Urinalysis		10 µg/L for any period

Nuclear Substance and Form	Action Level		
U in Airborne Contamination	Unclassified Area	R2 Area	R3 Area (non-mask)
	36 dpm/m^3	180 dpm/m^3	270 dpm/m^3

Table 6: Summary of Action Levels for the Radiation Protection Program at Toronto Facility

BWXT NEC has a well-established integrated management system for environmental, health and safety program excellence. The radiation protection program is effectively implemented. BWXT NEC has an established EHS Mission Statement that is reviewed and signed annually by the President of BWXT NEC. The Mission Statement includes a commitment to ALARA and continuous improvement. Elements of the radiation protection program such as dose monitoring, contamination monitoring, and radiation field surveys, etc. are conducted by qualified workers and reviewed internally by EHS staff and Committees on a regular basis. Details of the reviews are recorded in meeting minutes.

An internal audit and self-assessment of the radiation protection program, with a focus on elements of radiation protection program effectiveness and compliance, is conducted annually at each site. Non-conformances are addressed and tracked to completion in accordance with program requirements.

In accordance with the Radiation Protection Regulations and CNSC Guidance Document G-129, *Keeping Radiation Exposures and Doses As Low As Reasonably Achievable*, BWXT NEC has implemented a radiation protection program. This document establishes the radiation protection program in place at the Toronto and Peterborough facilities and identifies corresponding procedures to ensure that radiation exposures and doses are kept ALARA.

Key components of the radiation protection program include:

- Compliance with all relevant regulatory requirements;
- The setting of ALARA goals and objectives;
- Hazard recognition, risk assessment and change control processes;
- A comprehensive worker training program; and
- Documented safety concerns, near misses and incidents with appropriate root-cause analysis, preventive and corrective actions.

The radiation protection program includes all worker radiation safety elements that demonstrate compliance to relevant regulations, codes and standards:

- EHS policy commitment to ALARA
- Area classifications and requirements
- Material handling
- Non-routine or high-risk work controls
- Internal and external radiation hazard assessments
- Internal and external radiation monitoring and recording

Continuous improvement is achieved through several review processes, including site inspections, reported safety concerns, near miss and incident investigations, self-assessments, internal and external audits. During the reporting period, the radiation protection program was revised to include a basic process objective for liquid effluent. The revised manual was submitted to the CNSC. Additional minor continuous improvements were instituted as follows:

- For Peterborough,
    - The Non-NEW Radiation Dose Control work instruction was revised to remove the Action Level for consistency with the licence conditions handbook.
- For Toronto,
    - The Liquid Effluent work instruction was revised for clarify and to reflect current practices.
    - The Delayed Neutron Activation Analysis and Exhaust Air Sampling work instructions were revised to include a blank sample for quality control purposes.
    - The Radiation Instrumentation Calibration work instruction was revised to reflect current practices and include management system requirements.
    - The Uranium Analysis Efficiency Determination work instruction was revised to capture all swipes in the database and efficiency determination for a new radiation detection instrument.
- Minor administrative edits were made to seven other work instructions across both sites.

The radiation protection program is well-established and effective. Radiation dose trends demonstrate the company's commitment to ALARA. Program goals are monitored through the site's ALARA Committees as summarized in section 3.7.1.

3.7.1 ALARA Committee Performance

The ALARA committees work to review and continuously improve elements of the radiation safety program, and implement ALARA practices where practical in order to ensure that radiation dose levels are as low as reasonably achievable. Committee members consist of both unionized and management employees. The ALARA committees target quarterly meetings at a minimum. The Peterborough and the Toronto committees met four times each during the reporting period. Dose results, radiation protection related events, audits, and employee concerns were reviewed and discussed. Actions are assigned and tracked as part of the meeting minutes. Committee activities are communicated to all workers via email distribution or employee notice board postings.

ALARA Committee goals and results for the reporting period are provided in Table 7 and Table 8 for Peterborough and Toronto respectively. Goals that are not achieved are informally reviewed by the

ALARA Committee to discuss probable causes. The feasibility of achievement is discussed and implementation plans revised as needed. These are considered during future goal setting. As radiation doses continue to be well below the regulatory dose limits, dose reductions become increasingly challenging.

3.7.1.1 Peterborough ALARA Committee

Reporting period ALARA goals are summarized in Table 7. While Peterborough did not adopt a dose reduction goal due to known projects that were expected to increase pellet handling, the project occurred later in the year and the site did achieve a 5% dose reduction. The dose reduction is based on collective dose once it has been normalized with production quantities. This ensures the reductions in dose are not as a result of reductions in production amounts. TLD audits are conducted periodically to ensure workers are wearing and storing their dosimeters as required to ensure accurate measurements. While the 99% compliance goal was not achieved, 98% compliance overall demonstrates a strong adherence to requirements. The majority of misses were from employees working on the fuel shop floor without their dosimeter on. This was often as a result of shop coat changes, entering and exiting the building frequently, or changes in routine. Employees are reminded of the proper wear and care requirements when each miss occurs. Three misses within six months can result in disciplinary action for that employee. The TLD audit compliance goal will continue into 2021 to ensure that it remains a priority for employees and management.

Peterborough ALARA Committee Goals	Actual	Result
>99% compliance in TLD audits	98% compliance	Not Achieved
Complete one shielding project by year end	1/1	Achieved
Provide additional training to interested ALARA committee members by year end	Complete	Achieved

Table 7: Peterborough ALARA Committee Goals and Results

2021 goals for Peterborough are established as follows:

1. >99% compliance in TLD audits
2. Complete a shielding project by year end
3. Review the impact of sort and stack on radiation safety programs

3.7.1.2 Toronto ALARA Committee

Reporting period ALARA goals are summarized in Table 8. The targeted shielding project was postponed due to changes in the Sort & Stack area layout.

Toronto ALARA Committee Goals	Actual	Result
Review air sampling locations and positions	Complete	Achieved
Complete one shielding project by year end	Postponed	Not Achieved
ALARA presentation at all employee communication meeting	Complete	Achieved
Training ALARA Committee members (supplement to radiation safety)	Complete	Achieved

Table 8: Toronto ALARA Committee Goals and Results

2021 goals for Toronto are established as follows:

1. Implementation of shielding around storage of material in Sort & Stack and Wagon Storage Area.
2. ALARA presentation at all employee communication meeting.
3. Review portable air sampling in locations with no fixed air samplers (3 areas).
4. Review CNSC regulatory document 2.7.1, Radiation Protection and how it may impact site.

3.7.2 Radiation Protection Training Program and Effectiveness

Radiation protection training programs are compliant with the systematic approach to training methodology. An internal or external specialist in radiation protection periodically provides classroom training to new and continuing NEWs or those working in areas with radioactive materials. Online training is also available to employees with computer access. Testing is performed on completion of the training to demonstrate employee understanding. In Peterborough, radiation protection training is rolled into the site-wide Manufacturing Area Hazards Awareness course. Course content includes general shop floor rules, radiation fundamentals, sources of ionizing radiation, health effects, emergency response and other safety-related content. Training completion is monitored using a learning management software system, which tracks and triggers retraining as required. Course completion details are provided in section 3.3. Training effectiveness is monitored through radiation dose results, internal inspections, self-assessments and audits as well as incident investigations.

3.7.3 Radiation Device and Instrumentation Performance

Radiation detection instrument error can occur due to a variety of factors: drift, environment, electrical supply, addition of components to the output loop, process changes, etc. Each site maintains a system for managing radiation detection instrument calibrations. Calibration is conducted to ensure accurate indication during field use. Calibrations are performed under environmentally controlled conditions suitable for the inspections, measurements, and tests being performed, as determined by the equipment manufacturer. Calibration intervals are established, so that calibration occurs before any anticipated significant changes occur in measurement capability. Radiation detection equipment calibrations are conducted within 12 months of the previous calibration as required by regulation.

All active radiation devices and instruments were maintained in a state of safe operation. Where calibration is expired or where detectors fail calibration, they are removed from service until they are repaired and meet radiation calibration expectations.

There were no changes to the calibration program during the reporting period.

3.7.4 Contamination Control Data

When radioactive material is handled in a non-sealed container, there is the potential for it to be spread onto other objects. This is known as radioactive contamination. Radioactive contamination refers to nuclear substances on surfaces or within the air, where its presence is unintended or undesirable.

Surface contamination measurements (swipes) are conducted in manufacturing areas of each facility. The potential for surface contamination is greater in the Toronto facility since UO_2 powder is received and handled. Contamination by itself is not necessarily an indicator of exposure potential but can be used as an indicator of housekeeping conditions; however significant amounts of loose surface contamination has the potential to become airborne. If this occurs, the air monitoring results will reflect the increased airborne concentration and appropriate corrective action is then taken. Internal Control Levels are applied to each area classification. In the event a swipe measurement exceeds an Internal Control Level; the area is cleaned and re-swiped to verify cleanliness. Trends are monitored. There were no significant personnel contamination events during the reporting period.

3.7.4.1 Peterborough Surface Contamination

Routine surface contamination measurement results are summarized in Table 9. Peterborough surface contamination remains very low. Surface contamination results are reviewed by EHS staff and discussed if necessary at ALARA Committee Meetings. Overall, 100% of routine swipes were within Internal Control Levels, indicative of effective contamination control measures and cleaning schedules.

Peterborough Surface Contamination					
Classification and Area Description	Internal Control Level	2019		2020	
		Total Number of Samples	Total Number Samples Exceeding Internal Control Level (%)	Total Number of Samples	Total Number Samples Exceeding Internal Control Level (%)
R2 - Pellet Loading, Element Welding and Pellet Storage	2,200 dpm/100 cm^2	521	0 (0%)	621	0 (0%)
R1 - Bundle Assembly, Inspection, Receiving, Building 24	220 dpm/100 cm^2	183	0 (0%)	199	0 (0%)
Active - Met Lab, Waste Room	220 dpm/100 cm^2	164	1 (0.6%)	183	0 (0%)
Unclassified - Items, Main Hallway	220 dpm/100 cm^2	451	1 (0.2%)	478	0 (0%)

Table 9: Peterborough Surface Contamination

3.7.4.2 Toronto Surface Contamination

Routine surface contamination measurement results are summarized in Table 10. Toronto surface contamination remains fairly steady in the number of samples exceeding the Internal Control Levels. Surface contamination results are reviewed by EHS staff and discussed at WSC

Meetings. Overall, 99% of swipes were within Internal Control Levels, indicative of effective contamination control measures and cleaning schedules.

Toronto's surface contamination program was redesigned following a program review. Sample locations that historically showed no contamination have been moved to a quarterly frequency and work surfaces have been added with a monthly frequency. Respirator, TLD and miscellaneous sample locations have also been added into the program with a quarterly frequency.

Toronto Surface Contamination					
Classification and Area Description	Internal Control Level	2019		2020	
		Total Number of Samples	Total Number Samples Exceeding Internal Control Level (%)	Total Number of Samples	Total Number Samples Exceeding Internal Control Level (%)
R3-Powder Preparation, Pressing, Grinding, Laboratory	22,000 dpm/100 cm^2	447	3 (1%)	464	0 (0%)
R2-Sintering, Sorting & Stacking, Laboratory	2,200 dpm/100 cm^2	511	6 (1%)	518	7 (1%)
Active - Plant Washrooms, Laundry Room	2,200 dpm/100 cm^2	145	0 (0%)	120	0 (0%)
Unclassified	220 dpm/100 cm^2	294	6 (2%)	540	17 (3%)

Table 10: Toronto Surface Contamination

3.7.5 Air Monitoring

As part of well-established and implemented industrial hygiene programs, both facilities sample breathing air for measurement of uranium content. Workstation air monitoring is a key performance indicator that speaks to effective administrative and engineered controls. Respiratory protection programs are in place. Non-routine work functions, such as machine maintenance, modifications, etc. are controlled by EHS Work Permits (Peterborough) or Radiation Safety Instructions (Toronto). These processes specify protective measures, including those to reduce exposure to airborne UO_2. This may or may not include air monitoring and/or respirator use.

3.7.5.1 Peterborough Air Monitoring

In Peterborough, each process workstation where open UO_2 pellets are handled are periodically monitored during routine operations for airborne UO_2. All filter papers are counted in-house and verified by an independent external laboratory using delayed neutron activation analysis. Workstation air sampling results are summarized in Table 11.

Peterborough Workstation Air Monitoring	2016	2017	2018	2019	2020
Number of Workstations Sampled	4	4	4	4	4
Total Number of Samples Collected	50	46	49	47	47
Total Number of Samples Exceeding Internal Control Level (facility and area specific)	0	0	0	0	0
Total Number of Samples Exceeding Action Level (facility and area specific)	0	0	0	0	0
Average Concentration (dpm/m^3)	0.11	0.05	0.04	0.03	0.03
Maximum Value Recorded (dpm/m^3)	0.97	0.15	0.12	0.17	0.17

Table 11: Peterborough Workstation Air Monitoring Summary

In Peterborough, average and maximum workstation air monitoring results continue to remain negligible and well below Internal Control Levels. No trends are discernible.

3.7.5.2 Toronto Air Monitoring

In Toronto, each process workstation is monitored continuously during routine operating conditions for airborne UO_2 and counted in-house. Internal dose to workers in Toronto is estimated and assigned based on these air monitoring results. Workstation air sampling results are summarized in Table 12.

Toronto Workstation Air Monitoring	2016	2017	2018	2019	2020
Number of Workstations Sampled	21	21	21	21	21
Total Number of Samples Collected	5271	5208	5250	5292	5292
Total Number of Samples Exceeding Internal Control Level (facility and area specific)	2	1	5	8	6
Total Number of Samples Exceeding Action Level (facility and area specific)	0	0	0	0	0
Average Concentration (dpm/m^3)	9.2	7.1	9.6	8.8	6.7
Maximum Value Recorded (dpm/m^3)	244	306	365	433	368

Table 12: Toronto Workstation Air Monitoring Summary

In the reporting period, six workstation air samples exceeded an Internal Control Level in Toronto. The results were identified during the daily air sample result reviews. One was associated with Final Press #1, one was for the CANDU Sort/Stack, one was for the Grinder Swarf Collection, one was for the Decanning Area, and two were for the Final Press Feed #1 & 2.

The elevated result for Final Press #1 was related to maintenance of Torit #1 in the press area. The work involved changing the filters, vacuuming and clearing any blockage. Due to the nature of the work airborne uranium dust was generated. Maintenance employees wore respirators throughout the task. No intakes or exposures were observed for the maintenance employees.

The elevated result for CANDU Sort/Stack was related to maintenance work of a ventilation line. Maintenance was investigating low flow in Sort/Stack Line 1 ventilation and discovered a kink. The kink in the line was removed by cutting the line to make it more taught. Residual uranium dust in the line

became airborne. No operators were in the room and the maintenance employee wore a respirator. No intake or exposure was observed for the maintenance employee.

The elevated result for Grinder Swarf Collection was related to a new operator performing bowl dumping of swarf and blockage in the flex ventilation hose. The room is classified as an R3 masked area and employees are required to wear a respirator on entry. Maintenance removed solids in the hose and the supervisor reminded operators to use proper techniques when dumping bowls. No intakes or exposures were observed for the operator and maintenance employee.

The elevated result for the Decanning Area is related to cutting legacy material in the decan lathe. The legacy material was larger than normal and produced airborne uranium dust during the cutting process. The operators cut into two larger sized tubes, noticed some dust and immediately stopped work. The operator was not wearing a respirator at the time, as the lathe is under process ventilation. No intake or exposure was observed.

The two elevated results for Final Press Feed # 1 & 2 were associated with a filter dismantling trial. The work was performed in an R3 masked area and involved vibrating the filters, cutting the filter screens and removing the frames. Operators and maintenance wore respirators throughout the task as required the by the room classification. During the trial it was noted that dust became airborne. A vacuum hose also detached during the activity which led to more airborne dust. The work was stopped and alternative methods for filter dismantling are being reviewed. No intakes or exposures were observed for the operators and maintenance employee.

3.7.6 Facility Radiological Conditions

Radiation fields from use and storage of radioactive materials may result in external radiation doses to workers. In order to ensure that radiation dose rates are ALARA, routine gamma radiation surveys are conducted periodically within each facility using calibrated portable handheld radiation detectors. Measured dose rates are compared to targets for areas based on area classification and occupancy. When necessary, items are moved to alternative storage locations and/or temporarily shielded. Areas that appear routinely higher than target dose rates may be investigated for improvements, such as permanent shielding or reconfiguration. Routine dose rate measurements are summarized in Table 13 and Table 14 for Peterborough and Toronto respectively. Dose rates remain steady in both locations. The facility gamma surveys focus on radioactive material handling and storage areas and adjacent occupied locations. Variability due to the timing of the surveys is a factor in the results, as production levels and movement of materials vary over the course of a year.

Peterborough Dose Rates	2016	2017	2018	2019	2020
Total Number of Locations Surveyed	373	360	384	370	366
Average Dose Rate (µSv/h) on Shop Floor	3.1	3.0	3.1	3.4	2.7
Average Dose Rate (µSv/h) in Storage Areas	5.6	4.3	4.2	5.5	4.3

Table 13: Peterborough Routine Dose Rate Survey Summary

Toronto Dose Rates	2016	2017	2018	2019	2020
Total Number of Locations Surveyed	160	160	160	160	159
Average Dose Rate (µSv/h) on Shop Floor	2.7	2.6	3.0	2.4	3.9
Average Dose Rate (µSv/h) in Storage Areas	5.0	7.5	5.5	5.3	5.6

Table 14: Toronto Routine Dose Rate Survey Summary

3.7.7 Urinalysis Results

The presence of uranium in the urine is an indication of recent inhalation of UO_2 dust or the systemic clearance of an established thorax burden. At BWXT NEC, urinalysis is used as a screening tool to initiate further review of internal dose control measures and practices but is not used to estimate internal dose. In Toronto, internal dose is estimated based on workstation air monitoring (refer to section 3.7.9).

3.7.7.1 Peterborough Urinalysis Results

All Peterborough employees working where exposed UO_2 material is processed (R2 classified area) for a period greater than 30 hours per quarter, or working as a roving inspector during the quarter, submit urine samples for uranyl ion analysis. Samples are analyzed by an external laboratory for uranium content using Inductively Coupled Plasma - Mass Spectrometry with a minimum detectable concentration of 0.1 µg U/L. Results are compared to Internal Control Levels and Action Levels and entered and retained in an electronic database. Urinalysis results are summarized in Table 15.

Of all urinalysis samples from Peterborough processed between 2005 and 2020, <1% of samples (14/1964) have measured above the minimum detectable concentration of 0.1 µg U/L, and all were less than 0.5 µg U/L. These occurrences were well below the Internal Control Level of 5 µg U/L. This confirms that the inhalation hazards at the Peterborough facility are negligible and that current engineered and administrative controls, where applicable, are adequately controlling the risk.

Peterborough Urinalysis	2016	2017	2018	2019	2020
Number of urine samples analyzed	109	99	108	88	86
Number of samples above Internal Control Level (5 µg U/L)	0	0	0	0	0
Number of samples above Action Level (10 µg U/L)	0	0	0	0	0
Maximum result (µg U/L)	<0.1	<0.1	<0.1	0.1	0.4

Table 15: Peterborough Urinalysis Results Summary

3.7.7.2 Toronto Urinalysis Results

All Toronto employees working where exposed UO_2 material is processed submit urine samples for uranyl ion analysis weekly or monthly, depending on the work area. Samples are analyzed by an external laboratory for uranium content using Inductively Coupled Plasma - Mass Spectrometry with a minimum detectable concentration of 0.1 µg U/L. Results are compared to Internal Control Levels and Action Levels and entered and retained in an electronic database. Urinalysis results are summarized in Table 16.

In Toronto, there were no sample results above the Internal Control Level of 5 µg U/L during the reporting period. There were no Action Level exceedances. This demonstrates that current engineered and administrative controls, where applicable, are adequately controlling the inhalation hazard.

Toronto Urinalysis	2016	2017	2018	2019	2020
Number of urine samples analyzed	1907	1621	1600	1594	1646
Number of samples above Internal Control Level (5 µg U/L)	3	0	0	0	0
Number of samples above Action Level (10 µg U/L)	1	0	0	0	0
Maximum result (µg U/L)	13.0	4.9	3.5	3.8	4.0

Table 16: Toronto Urinalysis Results Summary

3.7.8 Radiation Doses

Radiation dose refers to the energy deposited or absorbed in materials through which it passes. Equivalent dose is used to assess how much biological damage is expected from the absorbed dose. It takes the properties of different types of radiation into account. Effective dose is used to assess the potential for long-term effects that might occur in the future. It is a calculated value, measured in milliSievert (mSv), which takes into account the absorbed dose to all organs of the body, the relative harm level of the type of radiation, and the sensitivities of each organ to radiation. All radiation exposures received by employees in the reporting period were within Internal Control Levels, Action Levels and regulatory limits. Action Levels are site specific and are accepted by the CNSC through the facility operating licence conditions handbook. Regulatory limits are specified in the Radiation Protection Regulations. Regulatory limits are listed in Table 17 and Table 18. All measured radiation doses received by individuals in the reporting period were within Internal Control Levels, Action Levels and regulatory limits.

Effective Dose Limits		
Person	**Period**	**Effective Dose (mSv)**
NEW, including a pregnant NEW	(a) One-year dosimetry period (b) Five-year dosimetry period	50 100
Pregnant NEW	Balance of the pregnancy	4
A person who is not a NEW (i.e. a member of the public)	One calendar year	1

Table 17: Regulatory Effective Dose Limits

Equivalent Dose Limits			
Organ or Tissue	**Person**	**Period**	**Equivalent Dose (mSv)**
Lens of an eye	(a) NEW (b) Any other person	One-year dosimetry period One calendar year	150 15
Skin	(a) NEW (b) Any other person	One-year dosimetry period One calendar year	500 50
Hands and feet	(a) NEW (b) Any other person	One-year dosimetry period One calendar year	500 50

Table 18: Regulatory Equivalent Dose Limits

All workers are classified as either NEWs or Non-NEWs. All NEWs are deemed to have a reasonable probability of receiving a dose of radiation that is greater than the prescribed limit for a member of the public (1 mSv/year) in the course of the person's work with nuclear substances or at our nuclear facilities. All Fuel Manufacturing NEWs at BWXT NEC are assigned personal passive dosimeters known as TLDs (thermoluminescent dosimeter). These passive dosimeters measure the whole body and skin doses received in each monitoring period. TLD rings are worn on certain employee's hands for a one-week period each quarter. The test results and the weekly hours of contact are used to estimate the extremity dose for that quarter. Both types of TLDs are exchanged monthly (Toronto) or quarterly (Peterborough), and analyzed by a CNSC licensed external dosimetry service provider. The dosimetry service provider

reports the measured doses to BWXT NEC and to the Health Canada National Dose Registry. On receipt, knowledgeable staff reviews the monitoring results, and compares them to associated Internal Control Levels, Action Levels and regulatory limits.

The annual dose assignment for employees at BWXT NEC consists of external (Toronto and Peterborough) and internal (Toronto) dosimetry inputs, for which dose summaries are tracked for quarterly, year-to-date, five-year and lifetime. All NEWs who are monitored for radiation exposure receive an annual dose letter identifying their annual dose.

BWXT NEC dosimetry results are summarized in the following sub-sections. Employees are divided into workgroups based on job function for dosimetry analysis and trending. Operators are employees who directly manufacture product. Technicians are employees who support the licensed activities, (Fuel Manufacturing or Fuel Handling and Engineered Solutions) e.g. electrical, mechanical, quality control, laboratory, etc. Staff includes management and professional employees who support the Operators and Technicians with the licensed activities and includes the Customer Site Representatives.

3.7.9 Total Effective Dose Equivalent (TEDE)

TEDE includes TLD monitored external and calculated internal dose based on workstation air monitoring at the Toronto site. As a result of operations involving sintered ceramic pellets, the Peterborough site does not have any measurable internal dose.

3.7.9.1 Peterborough TEDE

Table 19 provides a summary of TEDE dosimetry measurements with monitored workers grouped in various ranges of exposure. Peterborough does not have any measurable internal dose; therefore, the TEDE is the measured TLD external whole body dose. Approximately 74% of Peterborough's TEDE are less than 1 mSv.

Calendar Year	Total # Individuals	Peterborough Total # of Individuals in Dose Range (mSv)							
		0 - 1	1 - 5	5 - 10	10 - 20	20 - 50	50 - 100	100 - 200	200 - 500
2020	72	53	14	5	0	0	0	0	0
2019	71	51	15	5	0	0	0	0	0
2018	78	57	19	2	0	0	0	0	0

Table 19: Peterborough Total Effective Dose Equivalent Distribution

TEDE by workgroup is listed in Table 20. Note that average dose results include zero measurements. The average annual TEDE trend for all monitored individuals is shown in Figure 6. The total collective dose for 2020 was 80.6 mSv. The maximum individual five-year dose is well below the 100 mSv regulatory limit at 23.3 mSv (2016-2020). Overall, average TEDE is trending down. Maximum and average doses are also trending down in each workgroup. Dose reduction is occurring as result of ongoing efforts to improve ALARA awareness (e.g. use of leaded blankets on product) and TLD wear and storage compliance.

	Year	Peterborough			
		All Workgroups	Operators	Technicians	Staff
Maximum (mSv)	2020	6.51	6.51	1.36	0.35
	2019	5.76	5.76	1.11	0.85
	2018	6.53	6.53	0.67	1.03
	2017	5.05	5.05	0.61	0.79
	2016	5.82	5.82	1.13	0.75
Average (mSv/person)	2020	1.12	2.05	0.31	0.07
	2019	1.17	2.18	0.36	0.46
	2018	1.12	2.12	0.31	0.48
	2017	0.99	2.06	0.13	0.39
	2016	0.96	2.02	0.14	0.37

Table 20: Peterborough Total Effective Dose Equivalent Summary

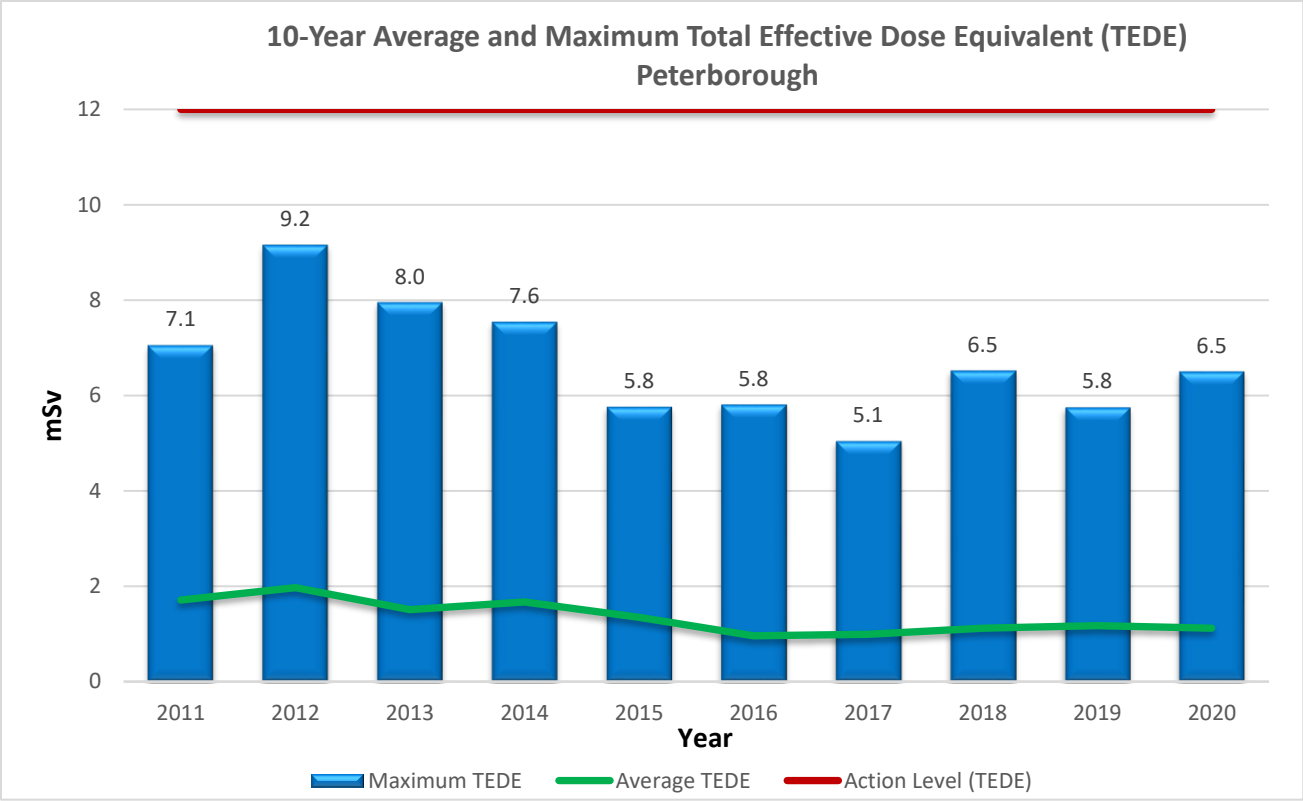

Figure 6: Peterborough 10-Year Annual Total Effective Dose Equivalent

3.7.9.2 Toronto TEDE

Table 21 provides a summary of TEDE dosimetry measurements with monitored workers grouped in various ranges of exposure. Approximately 48% of Toronto's TEDE are less than 1 mSv. TEDE measurement results by work group are summarized in Table 22. Note that average dose results include zero measurements. The total collective dose for 2020 was 105.8 mSv. The maximum individual five-year dose is well below the 100 mSv regulatory limit at 36.6 mSv (2016-2020).

The average annual TEDE trend for all monitored individuals is shown in Figure 7. Average TEDE is trending steady overall. Average and maximum Staff doses remain very low. Job rotation, shielding improvements made in the Sort and Stack, Grinding and Sintering areas are credited with the downward trend in maximum dose over the last several years. Additionally, improvements in ALARA awareness and operator experience are contributors.

Calendar Year	Total # Individuals	Toronto Total # of Individuals in Dose Range (mSv)							
		0 - 1	1 - 5	5 - 10	10 - 20	20 - 50	50 - 100	100 - 200	200 - 500
2020	58	28	24	6	0	0	0	0	0
2019	61	29	28	4	0	0	0	0	0
2018	58	28	26	4	0	0	0	0	0

Table 21: Toronto Total Effective Dose Equivalent Distribution

	Year	Toronto			
		All Workgroups (TEDE)	Operators External Only	Operators Internal Only	Staff (TEDE)
Maximum (mSv)	2020	7.39	6.31	1.64	0.21
	2019	7.17	6.10	1.55	0.72
	2018	9.16	8.07	1.86	2.06
	2017	8.54	8.54	2.37	0.40
	2016	11.79	11.79	2.80	0.23
Average (mSv/person)	2020	1.82	1.74	0.78	0.01
	2019	1.63	1.42	0.76	0.07
	2018	1.74	1.67	0.80	0.12
	2017	1.55	2.41	0.71	0.03
	2016	2.22	2.06	1.13	0.04

Table 22: Toronto TEDE, External and Internal Dose Summary

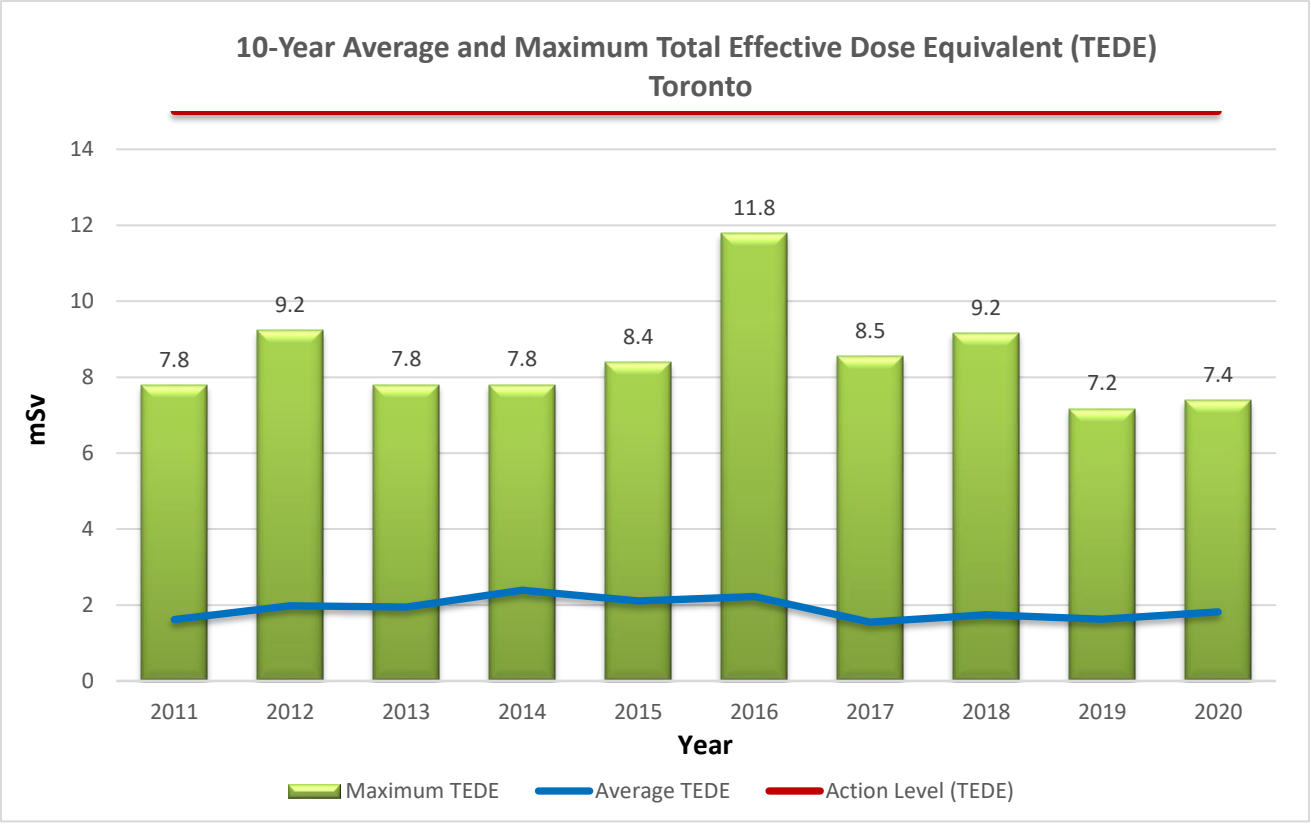

Figure 7: Toronto 10-Year Annual Total Effective Dose Equivalent

3.7.10 Equivalent Skin Dose

TLDs measure the skin doses received in each monitoring period. Skin dose is the measure of the radiation dose that is absorbed by the skin from the deposition of energy from low penetrating radiation.

3.7.10.1 Peterborough Skin Dose

Table 23 provides a summary of equivalent skin dosimetry measurements with monitored workers grouped in various ranges of exposure. Approximately 68% of Peterborough's skin doses are less than 1 mSv. Equivalent skin dose by work group is summarized in Table 24. The average annual skin dose trend for all monitored individuals is shown in Figure 8. Skin doses are trending downward across all workgroups and remain a fraction of the regulatory limit and Action Level.

Calendar Year	Total # Individuals	Peterborough Total # of Individuals in Dose Range (mSv)							
		0 - 1	1 - 5	5 - 10	10 - 20	20 - 50	50 - 100	100 - 200	200 - 500
2020	72	49	8	4	11	0	0	0	0
2019	71	47	9	4	11	0	0	0	0
2018	78	54	7	8	9	0	0	0	0

Table 23: Peterborough Equivalent Skin Radiation Dose Equivalent Distribution

	Year	Peterborough			
		All Workgroups	Operators	Technicians	Staff
Maximum (mSv)	2020	19.01	19.01	2.12	0.37
	2019	17.44	17.44	1.91	1.08
	2018	17.87	17.87	0.92	1.69
	2017	25.14	25.14	0.84	1.08
	2016	21.15	21.15	1.74	0.95
Average (mSv/person)	2020	2.81	5.37	0.45	0.08
	2019	3.00	6.16	0.48	0.49
	2018	2.87	6.05	0.38	0.57
	2017	2.77	6.26	0.17	0.49
	2016	2.66	6.11	0.18	0.39

Table 24: Peterborough Equivalent Skin Dose Summary

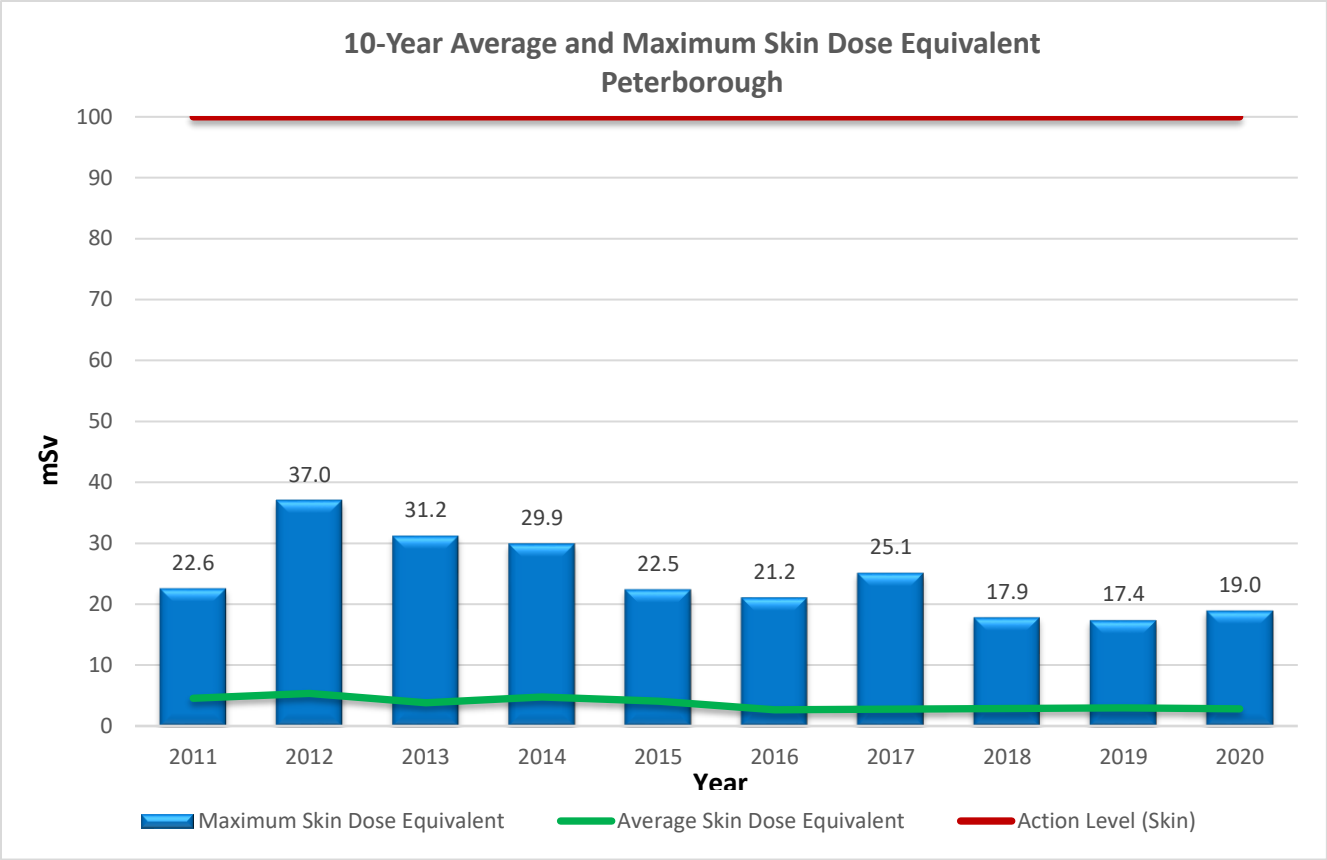

Figure 8: Peterborough 10-Year Annual Skin Dose Equivalent

3.7.10.2 Toronto Skin Dose

Table 25 provides a summary of equivalent skin dosimetry measurements with monitored workers grouped in various ranges of exposure. Approximately 41% of Toronto's skin doses are less than 1 mSv. Skin dose by workgroup is listed in Table 26. The average annual skin dose trend for all monitored individuals is shown in Figure 9.

Skin doses across all workgroups remain a fraction of the applicable regulatory limit and Action Level. The overall trend is showing that average skin dose is decreasing. The maximum skin dose has decreased in the recent year due to the introduction of job rotation at Sort and Stack. The year over year decrease in overall skin dose has resulted from a combination of job rotation, shielding improvements made in the Sort and Stack, Grinding and Sintering areas and an improvement in ALARA awareness and operator experience. While the primary objective of shielding improvements is reduction in gamma exposures, there is also a reduction in overall beta fields in the work area from the shielding.

Calendar Year	Total # Individuals	Toronto Total # of Individuals in Dose Range (mSv)							
		0 - 1	1 - 5	5 - 10	10 - 20	20 - 50	50 - 100	100 - 200	200 - 500
2020	58	24	10	5	7	12	0	0	0
2019	61	20	14	7	13	7	0	0	0
2018	58	19	9	11	11	6	2	0	0

Table 25: Toronto Equivalent Skin Radiation Dose Equivalent Distribution

	Year	Toronto		
		All Workgroups	Operators	Staff
Maximum (mSv)	2020	39.10	39.10	0.87
	2019	39.76	39.76	3.54
	2018	58.36	58.36	8.97
	2017	54.27	54.27	4.43
	2016	74.26	74.26	4.08
Average (mSv/person)	2020	8.88	12.24	0.07
	2019	8.07	10.85	0.27
	2018	8.92	12.68	0.54
	2017	7.85	11.80	0.34
	2016	10.23	14.82	0.49

Table 26: Toronto Equivalent Skin Dose Summary

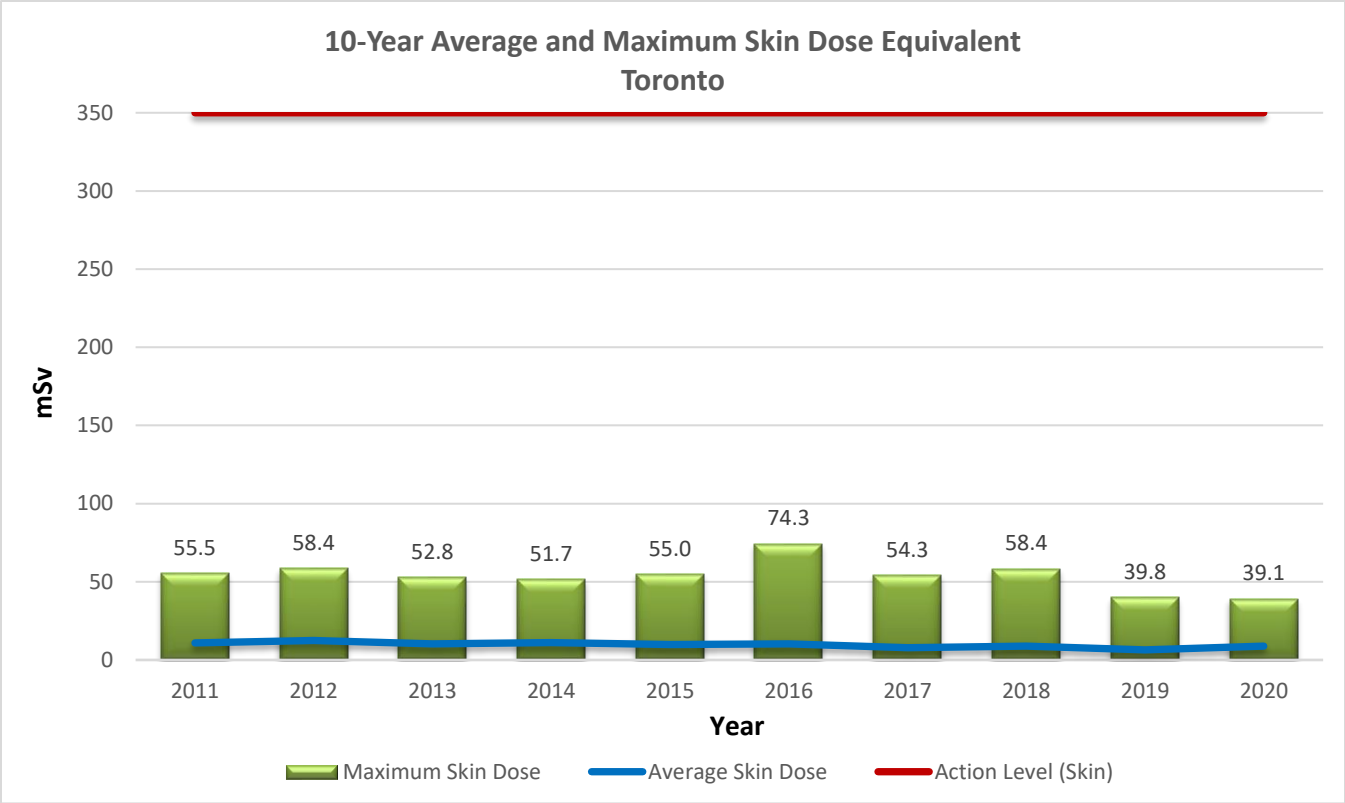

Figure 9: Toronto 10-Year Annual Skin Dose Equivalent

3.7.11 Equivalent Extremity Dose

TLD rings are worn on certain individual's hands for a one-week period each quarter to measure extremity dose. A scaling factor is calculated based on hours worked in the quarter and is provided to the dosimetry service provider each monitoring period. The dosimetry service provider applies the scaling factor to the measured dose to estimate the exposure for the quarter.

3.7.11.1 Peterborough Extremity Dose

Table 27 provides a summary of equivalent extremity dosimetry measurements with monitored workers grouped in various ranges of exposure. Approximately 66% of Peterborough's extremity doses are less than 20 mSv. Equivalent extremity dose by work group is summarized in Table 28. Staff and Technicians do not routinely participate in the extremity monitoring program since there is minimal direct handling of product. The average annual extremity dose trend for all monitored individuals is shown in Figure 10. Extremity doses across all workgroups remain a fraction of the regulatory limit and Action Level and show a steady average dose trend.

Calendar Year	Total # Individuals	Peterborough Total # of Individuals in Dose Range (mSv)							
		0 - 1	1 - 5	5 - 10	10 - 20	20 - 50	50 - 100	100 - 200	200 - 500
2020	18	0	2	3	7	6	0	0	0
2019	18	1	4	4	5	4	0	0	0
2018	27	6	0	6	8	7	0	0	0

Table 27: Peterborough Total Extremity Dose Equivalent Distribution

	Year	Peterborough			
		All Workgroups	Operators	Technicians	Staff
Maximum (mSv)	2020	43.17	43.17	N/A	N/A
	2019	29.41	29.41	N/A	N/A
	2018	46.06	46.06	0.68	0.88
	2017	43.18	43.18	1.20	2.17
	2016	32.84	32.84	3.6	2.25
Average (mSv/person)	2020	18.77	18.77	N/A	N/A
	2019	11.30	11.30	N/A	N/A
	2018	14.34	17.52	0.49	0.88
	2017	13.62	15.36	1.03	2.17
	2016	9.78	11.33	2.54	1.24

Table 28: Peterborough Equivalent Extremity Dose Summary

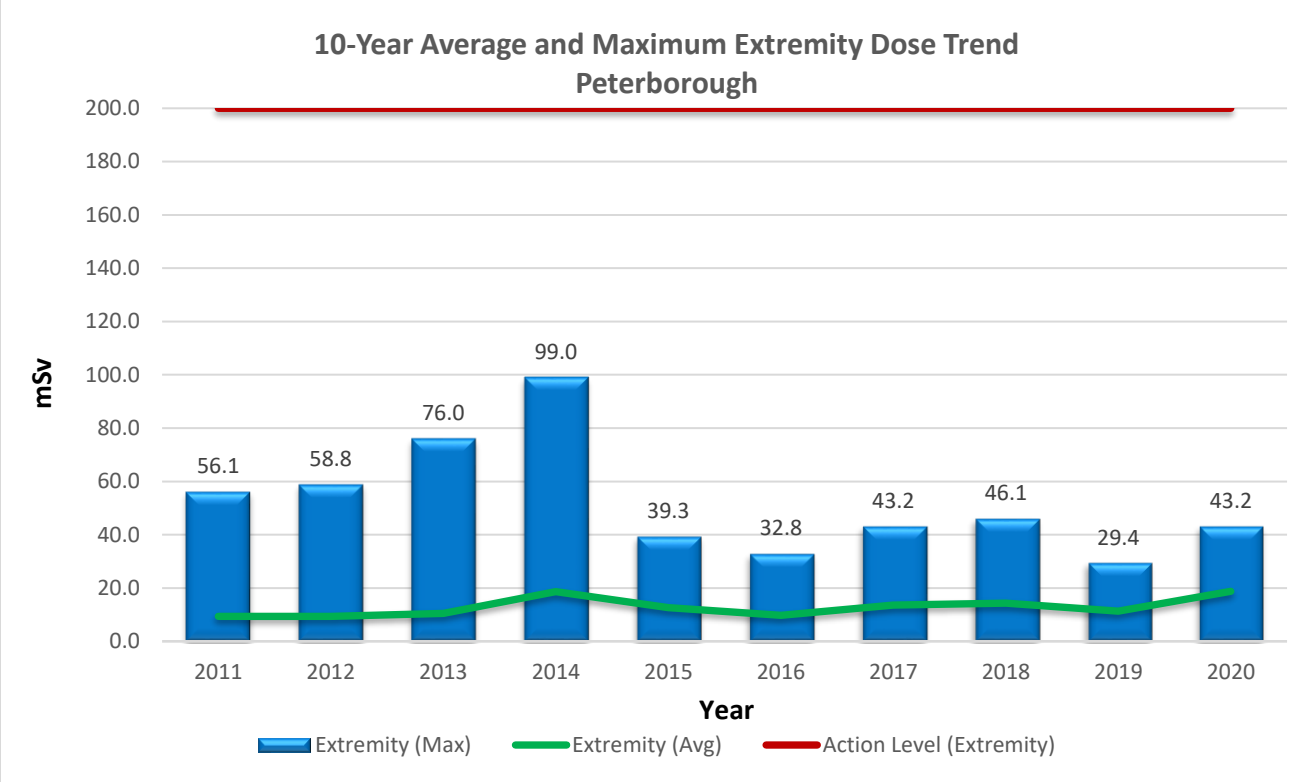

Figure 10: Peterborough 10-Year Average Annual Extremity Dose

3.7.11.2 Toronto Extremity Dose

Table 29 provides a summary of equivalent extremity dosimetry measurements with monitored workers grouped in various ranges of exposure. Approximately 60% of Toronto's extremity doses are less than 20 mSv. Equivalent extremity dose by work group is summarized in Table 30. Staff do not participate in the extremity monitoring program since there is minimal direct handling of product. The average annual extremity dose trend for all monitored individuals is shown in Figure 11. Average extremity doses continue to remain low with a slight increase from previous years due to new Operators in final inspection.

Calendar Year	Total # Individuals	Toronto Total # of Individuals in Dose Range (mSv)							
		0 - 1	1 - 5	5 - 10	10 - 20	20 - 50	50 - 100	100 - 200	200 - 500
2020	42	2	8	8	7	8	7	2	0
2019	45	2	10	9	8	11	5	0	0
2018	40	0	10	7	6	8	9	0	0

Table 29: Toronto Extremity Dose Equivalent Distribution

	Year	Toronto		
		All Workgroups	Operators	Staff
Maximum (mSv)	2020	115.52	115.52	N/A
	2019	79.67	79.67	N/A
	2018	83.33	83.33	N/A
	2017	115.07	115.07	N/A
	2016	119.47	119.47	N/A
Average (mSv/person)	2020	25.37	25.37	N/A
	2019	20.67	20.67	N/A
	2018	24.56	24.56	N/A
	2017	27.36	27.36	N/A
	2016	29.58	29.58	N/A

Table 30: Toronto Equivalent Extremity Dose Summary

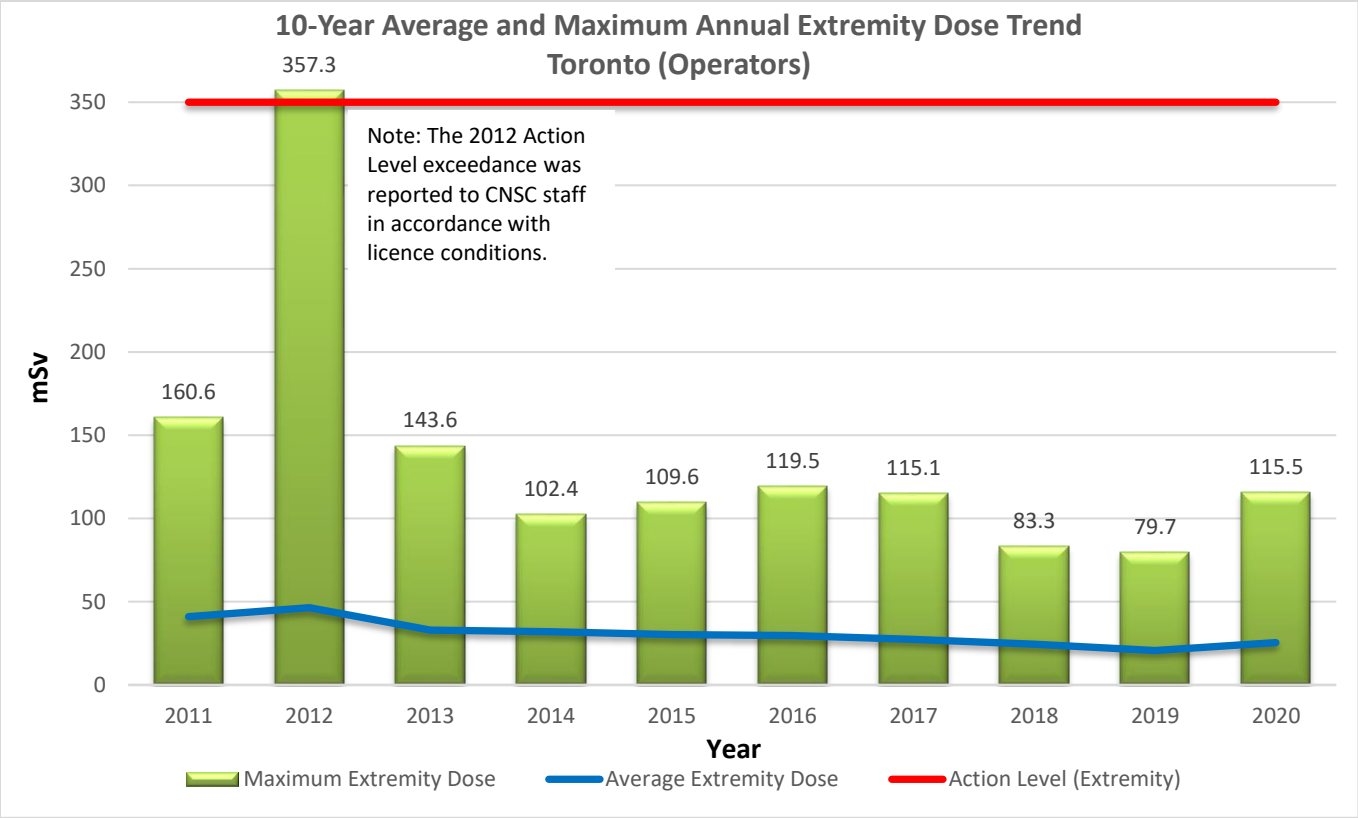

Figure 11: Toronto 10-Year Annual Extremity Dose

3.7.12 Total Estimated Doses to Members of the Public

Total effective radiation dose equivalent to members of the public are specified in the Radiation Protection Regulations and listed in Table 17. It is a calculated value, measured in mSv, which takes into account the absorbed dose to all organs of the body, the relative harm level of the radiation, and the sensitivities of each organ to radiation. To ensure compliance with this regulation, BWXT NEC has established “Derived Release Limits” (DRLs) for uranium emissions to the environment. The facility DRLs account for the realistic exposure pathways as described in the facilities radiation protection program to restrict dose to a member of the public to 1 mSv (1,000 µSv) per year, which is the regulatory dose limit. The DRLs assume that a member of the public occupies the BWXT NEC boundary continuously (24 hours per day, 365 days per year). Note: Liquid effluent is not included in the calculation of public dose as the effluent from both facilities is discharged directly to city sewer systems and is not used for drinking. Through direct correlation with the facility DRLs, the estimated effective dose as a result of air releases is calculated.

In addition, the contribution from gamma radiation emission to the nearest member of the public is calculated from the net sum of the nearest environmental TLD results from all monitoring periods. The calculation conservatively assumes that a member of the public occupies the nearest residence for 66% of their time for the entire year (5,781 hours in a non-leap year). Direct gamma emissions were included in the estimates starting in 2016 for Peterborough and 2014 for Toronto.

Over the reporting period, radiation doses to members of the public surrounding BWXT NEC facilities was a small fraction of the applicable regulatory dose limit as shown in Table 31, Table 32 and Figure 12 and Figure 13.

As a result of Peterborough operations, the total estimated radiation dose to a member of the public is 0.0 µSv (0.0 µSv from air emissions + 0.0 µSv from direct gamma radiation). In comparison to the 1 mSv (1,000 µSv) per year effective dose limit to a member of the public, dose from the operations is very low at 0%.

Period	Peterborough	
	Estimated Annual Public Dose (µSv)	% of Public Dose Limit (1,000 µSv = 1 mSv)
2020	0.0	0%
2019	11.5	1%
2018	0.0	0%
2017	0.0	0%
2016	0.0	0%

Table 31: Peterborough Estimated Radiation Doses to Members of the Public

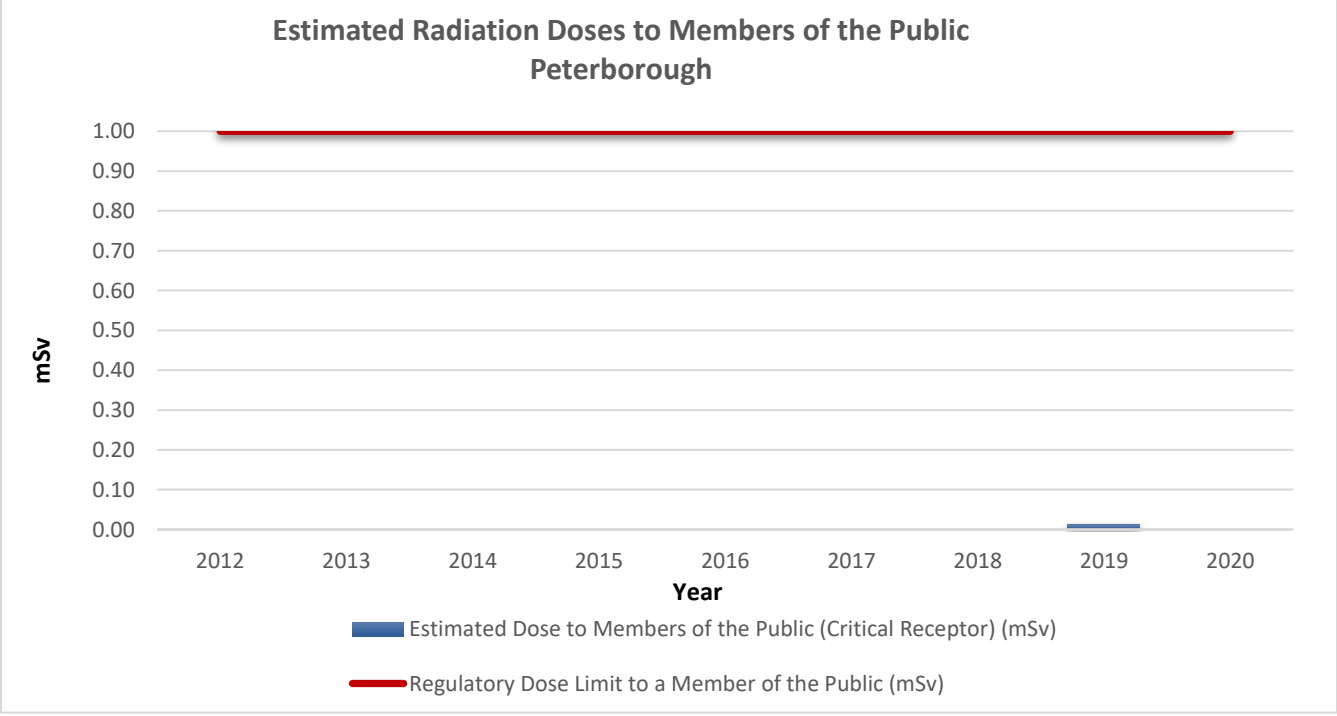

Figure 12: Peterborough Estimated Radiation Doses to Members of the Public

As a result of Toronto operations, the total estimated radiation dose to a member of the public is 5.8 µSv (0.05 µSv from air emissions + 5.7 µSv from direct gamma radiation). In comparison to the 1 mSv (1,000 µSv) per year effective dose limit to a member of the public, doses from the operations is very low at 1%.

Period	Toronto	
	Estimated Annual Public Dose (µSv)	% of Public Dose Limit (1,000 µSv = 1 mSv)
2020	5.7	1%
2019	23.5	2%
2018	0.4	0%
2017	17.5	2%
2016	0.7	0%

Table 32: Toronto Estimated Radiation Doses to Members of the Public

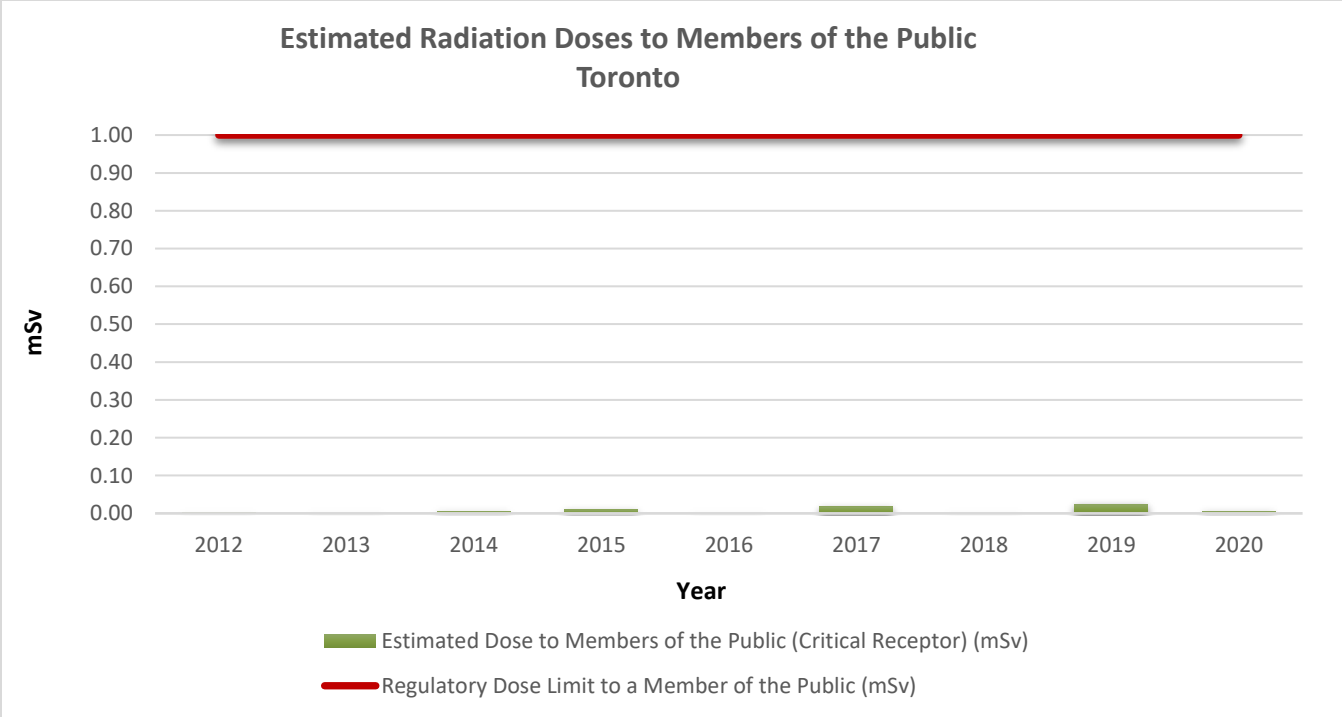

Figure 13: Toronto Estimated Radiation Doses to Members of the Public

3.8 Conventional Health and Safety

The "Conventional Health and Safety" Safety and Control Area covers the implementation of a program to manage non-radiological workplace safety hazards and to protect personnel and equipment.

BWXT NEC has a well-established integrated management system for environmental, health and safety program excellence. This is ensured through the effective implementation of program elements. BWXT NEC has an established EHS Mission Statement that is reviewed and signed annually by the President of BWXT NEC. BWXT NEC's objective is to eliminate or minimize as low as reasonably achievable both known and potential environmental, safety and health hazards which could impact our employees and the communities in which they live. EHS is a shared responsibility, top business priority and is continually improved.

Key components of the Health and Safety program include:

- Compliance with all safety and health-related regulatory requirements;
- The setting of EHS goals and objectives;
- Hazard recognition, risk assessment and change control processes;
- A comprehensive worker training program;
- Documented safety concerns, near misses and incidents with appropriate root-cause analysis, preventive and corrective actions.

The EHS program includes all worker safety elements that demonstrate compliance to relevant regulations, codes and standards:

- EHS Policy
- Hazard Analysis and Regulatory Compliance
- Employee Involvement
- EHS Specialist
- Accident/Incident Investigation
- EHS Training
- Housekeeping
- Personal Protective Equipment
- Contractor Safety
- Emergency Preparedness/Response
- Risk Assessments
- High Risk Operations
- Industrial Hygiene
- Chemical Management
- Ergonomics
- Lock-Out Tag-Out

Continuous improvement is achieved through several review processes, including site inspections, reported safety concerns, near miss and incident investigations. The effectiveness of the overall program is reviewed throughout the year and evaluated in the annual management review (section 3.2.3).

3.8.1 Workplace Safety Committees

3.8.1.1 Peterborough WSC

In Peterborough, ten meetings were held with quorum. A total of 53 investigations and inspections were conducted in the reporting period. This includes WSC inspections, manager inspections, and near miss, incident and injury investigations. These investigations and inspections led to a total of 84 actions logged and tracked to closure. In Peterborough, the top finding categories were 'housekeeping,' 'emergency equipment,' 'chemical management,' and 'walking/working surfaces.' Established WSC goals for the reporting period are summarized in Table 33.

Peterborough WSC Goals	Actual	Result
Meet at least 9 times/year	10/9	Complete
Improve recognition program	1/1	Complete
Review one EHS Program. COVID-19 Procedures.	1/1	Complete
Inspection tour completion target of 24 out of a possible 36 (12 months x 3 areas).	1/1	Complete

Table 33: Peterborough Workplace Safety Committee Goals and Results

2021 goals for Peterborough are established as follows:

1. Meet at least nine times as required by the Canada Labour Code Part II
2. WSC cross-NEC site sharing of safety trends and initiatives in 2021
3. Review Sort and Stack Changes including ALARA, ergonomics and cumulative impacts to area.
4. Inspection tour completion target of 24 out of a possible 36 (12 months' x 3 areas).

3.8.1.2 Toronto WSC

In Toronto, nine meetings were held with quorum. A total of 31 investigations and inspections were conducted in the reporting period. This includes WSC inspections, and near-miss, incident and injury investigations. The WSC inspections led to 150 actions logged and tracked to closure. The top finding categories from WSC inspections were 'housekeeping,' 'fire protection,' 'unsafe condition,' and 'chemical.' Established goals for the reporting period are summarized in Table 34.

Toronto WSC Goals	Actual	Result
Improve closure tracking/follow-up on inspection items	Completed	Achieved
Review one EHS program per quarter to promote program compliance	Completed	Achieved
Presentation on selected topics at all employee meeting	Completed	Achieved

Table 34: Toronto Workplace Safety Committee Goals and Results

2021 goals for Toronto are established as follows:

1. Review two EHS Programs for compliance and improvements by year-end.
2. Workplace Safety Committee training
3. Conduct joint committee meeting with other EHS teams by year-end

3.8.2 Hazardous Occurrences

Under the Canada Occupational Health and Safety Regulations there are several different types of hazardous occurrences including:

- Minor Injury: any employment injury or an occupational disease for which medical treatment is provided and excludes a disabling injury.
- Disabling Injury: any employment injury or an occupational disease that results in either time loss, or modified duties. Disabling injuries can be either temporary (sprained wrist), or permanent (severed limb), depending on whether or not the employee is expected to make a full recovery.
- Loss of Consciousness: from an electric shock or a toxic or oxygen deficient atmosphere.
- Rescue / Revival or other Emergency Procedures: any incident that requires emergency procedures to be implemented, such as a hazardous substance spill, bomb threat or violence prevention procedure.

Annual reports are provided to the Minister Employment and Social Development Canada as required by regulation.

3.8.2.1 Injuries and Illness

As can be seen in Table 35, BWXT NEC has had six consecutive years without a Lost Time Injury (LTI).

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Peterborough	0	0	0	0	0	0	0	0	0	0
Toronto	0	1	0	1	0	0	0	0	0	0

Table 35: Lost Time Injuries

Additionally, the Peterborough site did not experience any recordable injuries nor lost time injuries. During the reporting period there were 14 first aids. The top injury categories were ‘forceful exertion,’ ‘contusion/bruise,’ ‘falls same level,’ ‘strain/sprain,’ and ‘struck against.’ There were 47 near misses logged following defined event classification criteria. The top noted categories were ‘material handling,’ ‘walking and working surfaces,’ and ‘equipment operation.’

In Toronto, there were seven first aids and one recordable injury (no lost time). Six out of the eight injuries involved an injury to the hand or arm. The accident type associated with the injuries varied including ‘contact with a sharp object,’ ‘falls same level,’ ‘slip/trip same level’ and ‘body position/posture.’ There were 12 near miss events logged following defined event classification criteria. The top three noted categories were ‘radiation,’ ‘safety,’ and ‘industrial hygiene.’

3.9 Environmental Protection

The "Environmental Protection" Safety and Control Area covers programs that monitor and control all releases of nuclear and hazardous substances into the environment, as well as their effects on the environment as a result of licensed activities.

BWXT NEC has an effective environmental protection program in place which identifies and controls environmental aspects and drives continuous improvement to enhance performance and minimize risk to employees and the public. The facilities have well-established environmental management systems to ensure effective monitoring programs are in place to achieve environmental goals and regulatory compliance. Environmental protection programs are compliant with:

- CSA N288.6-12, *Environmental risk assessments at Class I nuclear facilities and uranium mines and mills*,
- CSA N288.5-11, *Effluent monitoring programs at Class I nuclear facilities and uranium mines and mills*, and
- CSA N288.4-10, *Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills*.

3.9.1 Environmental Risk Assessment

Environmental Risk Assessments specific to the Toronto and Peterborough facilities have been completed in accordance with CSA N288.6-12. The ERAs concluded that emissions from the facility were very low and no adverse effects to human health are expected.

The emissions of non-radioactive contaminants from the facility were below the MECP point of impingement (POI) standards; and water releases are also assessed to be minimal. Hence, it was concluded that the emissions of non-radiological substances resulting from the BWXT NEC facilities pose no adverse effect to human health.

The Environmental Risk Assessments also concluded that emissions of radioactive and non-radioactive materials from the facility pose no adverse effects to non-human biota.

3.9.2 Environmental Management System

BWXT NEC has a well-established integrated management system for environmental, health and safety program excellence. This is ensured through the effective implementation of program elements. BWXT NEC has an established EHS Mission Statement that is reviewed and signed annually by the President of BWXT NEC. BWXT NEC's objective is to eliminate or minimize as low as reasonably achievable both known and potential environmental hazards which could impact our employees and the communities in which they live. EHS is a shared responsibility, top business priority and is continually improved.

An Environmental Management System is in place to identify and control environmental aspects and drive continuous improvement to enhance performance and minimize risk to the employees and the public.

Key components of the environmental protection program include:

- Compliance with all environmental-related regulatory requirements;
- The setting of environmental goals and objectives;
- Hazard recognition, risk assessment and change control processes;
- A comprehensive worker training program;

- Documented environmental concerns, near misses and incidents with appropriate root-cause analysis, preventive and corrective actions.

The EHS program includes all environmental protection elements that demonstrate compliance to relevant regulations, codes and standards:

- Air
- Water
- Waste
- Dangerous goods shipping
- Boundary radiation monitoring
- Soil sampling (Toronto)

Continuous improvement is achieved through several review processes, including site inspections, reported concerns, near miss and incident investigations, self-assessments and audits. Environmental goals performance is discussed in 3.9.4. An annual internal self-assessment and audit of the environmental protection program elements are conducted at each facility (3.2.1 and 3.2.2). Following these proactive reviews, the findings are documented, corrective actions identified and tracked to completion.

Internal inspections are completed on a routine basis and focus on all areas of the plant. The purpose of these inspections is to identify environmental as well as health and safety issues. WSC members carry out routine plant inspections. After an inspection, the findings are documented, corrective actions identified, and submitted to responsible personnel to address. Depending on the complexity of the finding immediate action may be required (i.e. equipment shutdown), or the action may be incorporated into meeting minutes, or tracked in the ATS.

At the Peterborough site, a new ventilation filtration unit was installed to service the uranium processing area and replaces an existing system that serviced the decan hood. The new extraction fan and bag-in bag-out HEPA filter box was installed to capture debris and potential dust during the sorting and stacking of pellets in the R2 area.

In Toronto, a review of differential pressure settings was completed to ensure that early warning of potential filter issues (e.g. not seated properly, damaged) is triggered. In addition, investigations continued into improvements to the water treatment processes.

In the reporting period, minor administrative updates were made to three environmental documents.

3.9.3 Effluent and Environmental Monitoring Programs

Small amounts of radiological and non-radiological substances are released to the environment as the result of operations at BWXT NEC. Environmental protection is regulated municipally for water effluent through sewer-use by-laws, provincially for air effluent and federally by the CNSC for both air and water. Airborne and waterborne radiological and non-radiological emissions to the environment are monitored as part of the effluent monitoring programs. BWXT NEC's effluent and environmental monitoring program is comprised of the following components:

1. Air effluent
2. High-volume ambient air
3. Water effluent

4. Soil sampling

BWXT NEC has established facility specific CNSC approved Action Levels for various environmental parameters. An Action Level is defined in the Radiation Protection Regulations as “specific dose of radiation or other parameter that, if reached, may indicate a loss of control of part of a licensee’s radiation protection program, and triggers a requirement for specific action to be taken.” Action Levels are also applied to environmental protection. Action Levels are set below regulatory limits; however, they are CNSC reportable events. Accordingly, BWXT NEC has established Internal Control Levels for various environmental parameters that are set even lower than Action Levels to act as an early warning system. Internal Control Level exceedances trigger an internal investigation and corrective actions; however, they are not CNSC reportable events. During the reporting period, basic process objectives were established for liquid effluent. No regulatory limits or Action Levels were exceeded during the reporting period.

3.9.3.1 Independent Environmental Monitoring Program

To complement existing and ongoing compliance activities and site monitoring programs, the CNSC implemented its Independent Environmental Monitoring Program to verify that the public and environment around CNSC-regulated facilities are not adversely affected by releases to the environment. This verification is achieved through independent sampling and analysis by the CNSC. This program applies to the BWXT NEC operations. Sampling was last conducted in 2019. The results are compared to relevant provincial and federal guidelines and are available on the CNSC website.

3.9.4 Peterborough Environmental Protection Program Performance

Environmental protection goals and results are summarized in Table 36.

Peterborough Environmental Protection Program Goals	Actual	Result
Implement a reduction in electricity usage (10% from highest monthly) by year end	14%	Achieved
Complete one asbestos abatement project by year end	1	Achieved
Perform off-site soil sampling for beryllium	Complete	Achieved

Table 36: Peterborough Environmental Protection Program Goals

2021 goals for Peterborough are established as follows:

1. Develop and implement an annual soil sampling program for beryllium and uranium.
2. Complete one asbestos abatement project by year end

3.9.5 Toronto Environmental Protection Program Performance

In the reporting period, work continued related to the installation of a Maintenance Access Hole or alternate sampling device as requested by the City of Toronto. A suitable location was determined, building permit obtained and a contractor selected. This work continues in 2021. This activity is related to a previous City of Toronto routine inspection assessing compliance with municipal environmental legislation regarding water emissions. The governing legislation includes the City of Toronto Sewer Use By-Law.

Initial investigation was done on optimizing the waste water treatment process (i.e. ultrafiltration, upgrades to current technology) but this was not pursued in 2020.

Environmental protection goals and results are summarized in Table 37.

Toronto Environmental Protection Program Goals	Actual	Result
Installation of plant sewer outlet sampling device	~50% Complete	Not Achieved
6h68 ventilation system assessment and balancing	Complete	Achieved
Optimize waste water treatment process and capacity	Cancelled	Not Achieved

Table 37: Toronto Environmental Protection Program Goals

2021 goals for Toronto are established as follows:

1. Installation of plant sewer outlet sampling device
2. Investigate use of filter aid on filter press filters and impact on water emission results.
3. Powder recovery from exhaust filters.

3.9.6 Air Effluent Monitoring

BWXT NEC facilities have valid Environmental Compliance Approvals issued by the Ministry of Environment, Conservation and Parks (MECP) for air emissions. In accordance with permit conditions, each site maintains emission summary and dispersion modelling reports and acoustic assessment reports that demonstrate compliance to relevant legislation. Annual summary reports are submitted to the MECP.

Measured uranium air emissions are included in the estimated dose to members of the public through direct correlation with facility DRLs. Details are provided in section 3.7.12.

3.9.6.1 Peterborough Air Monitoring

A single process uranium air emission point exists in the Peterborough facility. The R2 Area Decan Station was replaced with a new exhaust system in 2020. Both the old and new systems exhaust through a High Efficiency Particulate Air filter. The facility performs continuous in-stack monitoring drawing a sample of air across a filter capable of trapping uranium dust. The filter papers are analyzed in-house and verified externally by an independent laboratory by delayed neutron activation analysis. The minimum detection limit is 0.01 µg uranium. Results are compared to the previous results and to relevant Internal Control Levels and Action Levels.

The Peterborough facility uses beryllium as part of the fuel bundle manufacturing process. The Environmental Protection Act of Ontario (R.S.O. 1990, c. E. 19) and Ontario Regulation 419/05 Air Pollution – Local Air Quality determine the permitted concentration of contaminant release. The limit at the POI for Beryllium is 0.01 µg per cubic meter of air (µg/m^3). The POI is the plant/public boundary. In accordance with the relevant provincial regulations, an Environmental Compliance Approval is valid for the site's operations with modelling in place to confirm compliance.

Three beryllium air emission points exist in the Peterborough facility. Monitoring of this emission is not required by the MECP as the emissions are deemed to be insignificant in accordance with MECP methodology. Due to the additional regulation by the CNSC, BWXT NEC monitors the contaminant concentration in each stack and has an established Action Level of 0.03 µg/m^3 and an Internal Control Level of 0.01 µg/m^3 at the stack exit, which are both very conservative. The facility performs continuous in-stack monitoring drawing a sample of air across a filter capable of trapping beryllium. The filter is analyzed for beryllium using the Atomic Absorption method or the Inductively Coupled Plasma - Atomic

Emission Spectrometer method at an accredited external independent laboratory. The result is related to the air volume passed through the filter. The minimum detection limit is 0.002 µg beryllium. A calculation of the concentration is then made based on the volume of air drawn across the filter. These values are compared to the previous results, and to relevant Internal Control Levels and Action Levels.

A summary of air effluent sampling results is in Table 38. Uranium air release results continue to remain low and well below the Action Level of 1 µg/m^3. The ten-year trend graph of annual uranium air releases, presented in Figure 14, shows a stable performance consisting of very low measurements. Total releases were revised for 2016, 2017 and 2019. The total release of 0.003 g in the reporting period is well below the regulatory established discharge limit of 550 g per year. The ten-year trend graph of annual beryllium air concentrations presented in

Figure 15 shows a stable performance consisting of very low measurements.

Peterborough Air Emissions						
Stack Description	**Emission Contaminant**	**Total Number of Samples**	**Action Level (µg/m^3) (# Samples Exceeding Level)**	**Highest Value Recorded (µg/m^3)**	**Average Value Recorded (µg/m^3)**	**Total Discharge (g)**
R2 Decan	Uranium	48	1.0 (0)	0.003	0.001	0.003
North	Beryllium	48	0.03 (0)	0.001	0.000	N/A
Acid	Beryllium	47	0.03 (0)	0.001	0.000	N/A
South	Beryllium	48	0.03 (0)	0.000	0.000	N/A

Table 38: Summary of Peterborough Monitored Air Emissions

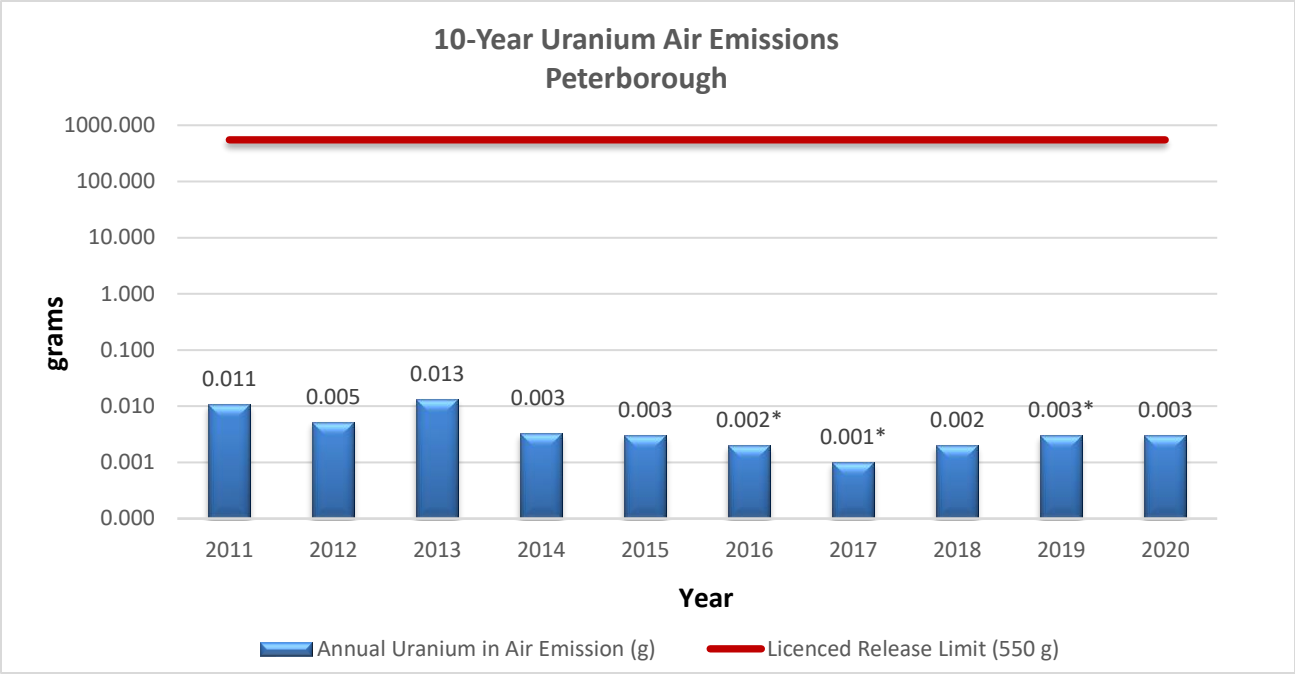

Figure 14: Peterborough 10-Year Annual Uranium Air Emissions

Note: The above graph has a logarithmic scale.

*Value revised from original report.

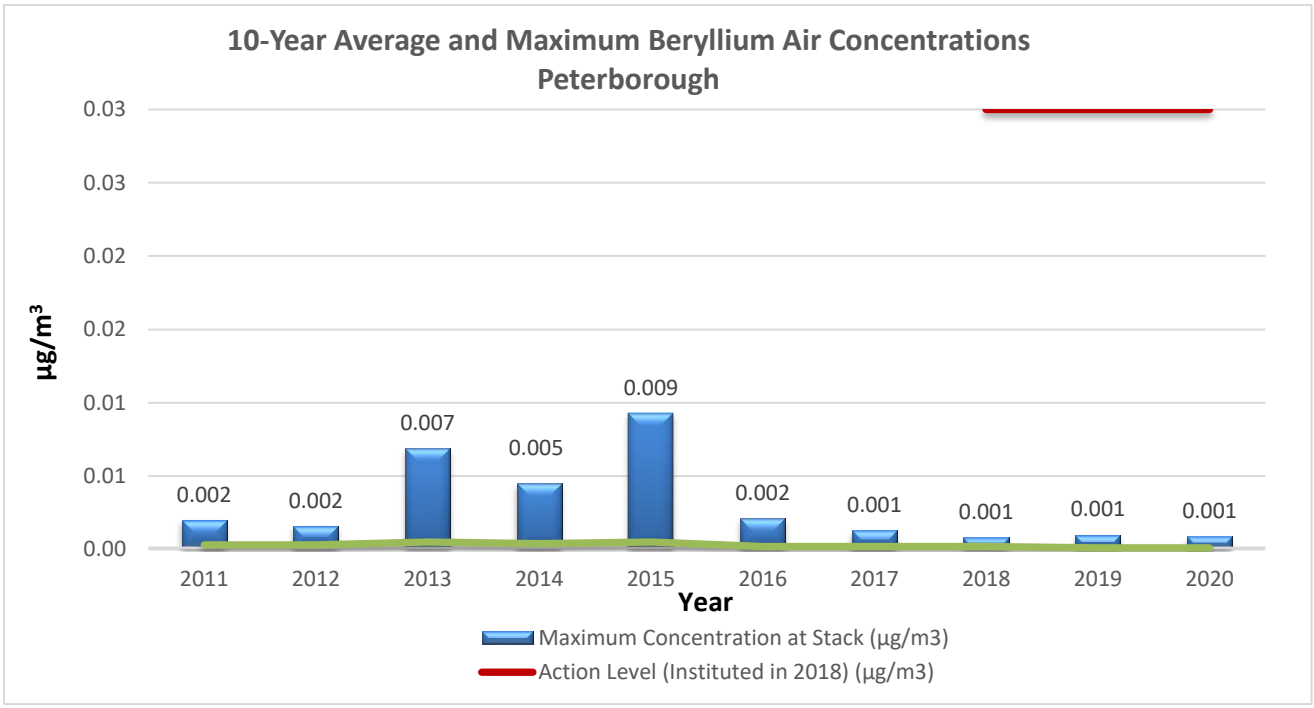

Figure 15: Peterborough 10-Year Annual Beryllium Air Concentrations

3.9.6.2 Toronto Air Monitoring

The Toronto facility performs continuous in-stack sampling and boundary air monitoring for uranium. The facility performs continuous in-stack monitoring drawing a sample of air across a filter capable of trapping uranium dust. The samples are analyzed in-house daily and verified externally by an independent laboratory. Boundary samples are high volume air samples drawn at five positions strategically located around the facility perimeter. Boundary samples are analyzed externally by an independent laboratory. In both cases the external independent laboratory tests the filter papers by delayed neutron activation analysis. The minimum detection limit is 0.01 µg uranium. Results are compared to the previous results, and to relevant Internal Control Levels and Action Levels.

A summary of air effluent sampling results is in Table 39 and Table 40. Air monitoring results are trended over ten years as shown in Figure 16 and

Figure 17. The Toronto stack air emission is trending down, with a steady trend in recent years. The total release of 8 g during the reporting period is well below the discharge limit of 760 g. The total release includes all monitored locations (Rotoclone, 6H-68, 4H-48, Furnace #1, Furnace #2/4 and Furnace #5/6). The downward trend is primarily the result of measured furnace stack emissions starting in 2016, rather than the conservative estimates applied prior. In addition, the furnace filter housings were replaced in late 2016 to improve performance and ease of maintenance tasks including filter changes. Air emission concentrations are reported using third party measurements, with exception of the highest value recorded, which is reported as in-house values.

Toronto's average boundary monitor results are trended over ten years in

Figure 17 and consist of very low uranium in air concentrations. The boundary air monitor maximum concentration measurements also continue to remain low and well below the Action Level of 0.08 µg/m^3.

Toronto Uranium in Air Emissions						
Stack Description	**Emission Contaminant**	**Total Number of Samples**	**Action Level (µg/m^3) (# Samples Exceeding Level)**	**Highest Value Recorded (µg/m^3)**	**Average Value Recorded (µg/m^3)**	**Total Discharge (g)**
Rotoclone	Uranium	251	1.0 (0)	0.204	0.014	1.07
6H-68	Uranium	251	1.0 (0)	0.112	0.013	2.18
4H-48	Uranium	251	1.0 (0)	0.112	0.016	0.45
Furnace #1	Uranium	251	1.0 (0)	0.599	0.088	1.73
Furnace #2/4	Uranium	251	1.0 (0)	0.158	0.036	0.48
Furnace #5/6	Uranium	251	1.0 (0)	0.908	0.168	2.29

Table 39: Summary of Toronto Uranium in Air Emissions

	Toronto				
	2016	**2017**	**2018**	**2019**	**2020**
Number of Boundary Air Samples Taken	260	260	260	260	265
Number of Samples > Action Level (0.08 µg/m^3)	0	0	0	0	0
Average Concentration (µg U/m^3)	0.001	0.000	0.000	0.000	0.000
Highest Value Recorded (µg U/m^3)	0.039	0.008	0.003	0.001	0.003

Table 40: Summary of Toronto Boundary Air Quality Monitoring

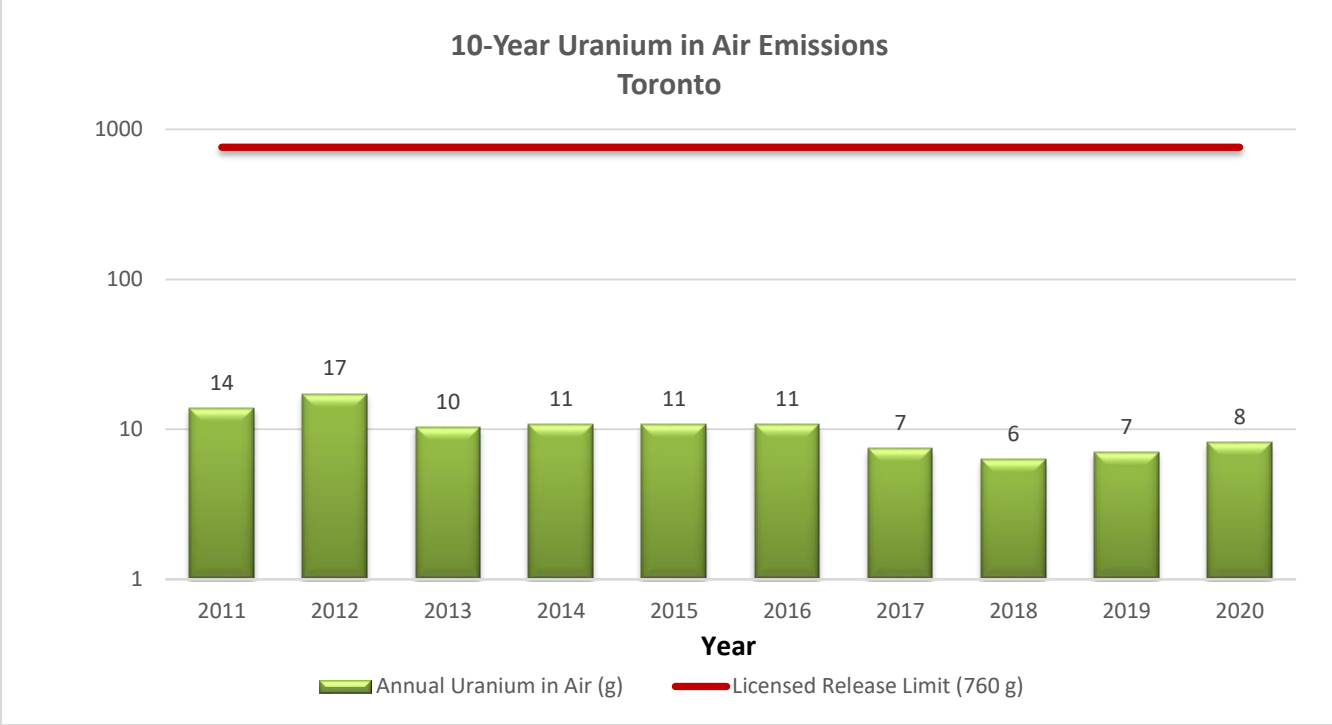

Figure 16: Toronto 10-Year Annual Uranium Air Emissions

Note: the above graph has a logarithmic scale

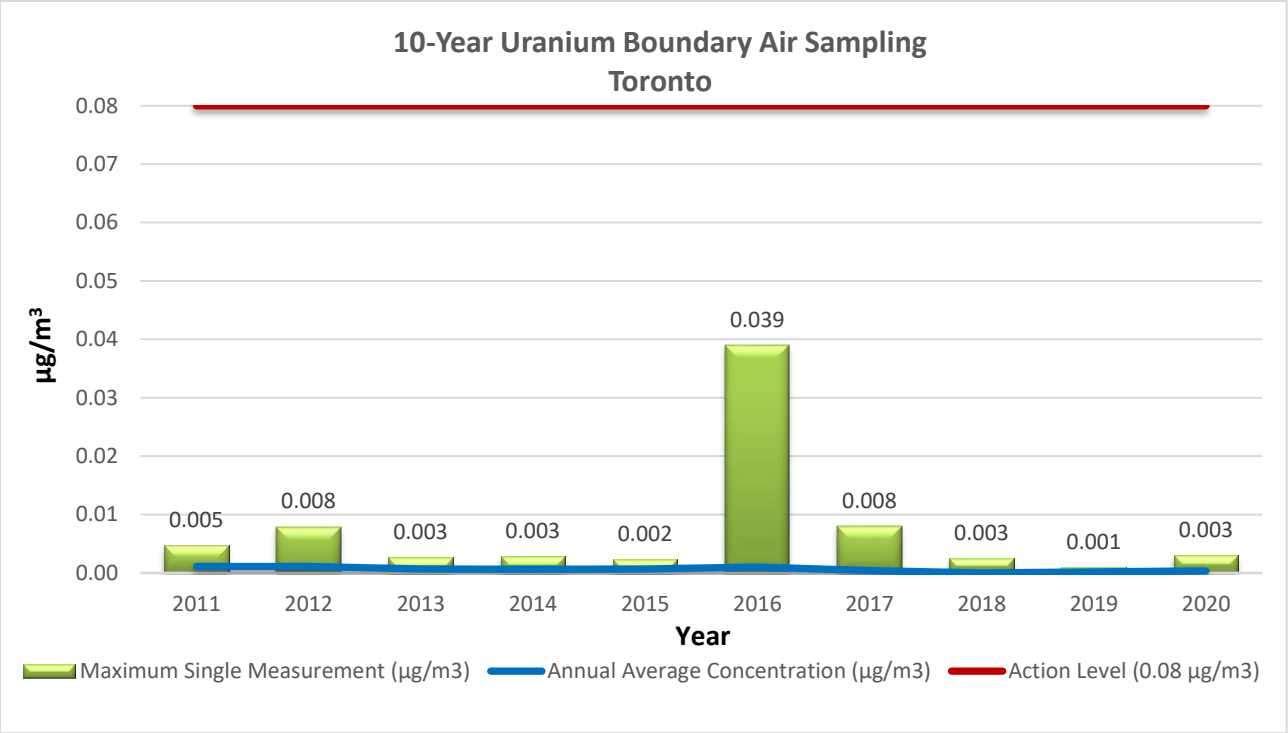

Figure 17: Toronto Annual Boundary Air Monitor Concentration

3.9.7 Water Effluent Monitoring

3.9.7.1 Peterborough Water Monitoring

All potentially uranium-contaminated wastewater is held for determination of the quantity and concentration of uranium prior to discharge. Liquid waste generated from routine activities, such as washing floors, walls and equipment in the uranium pellet loading and end closure weld area, is held in a 205 Litre (45-gallon) drum stored in the maintenance area. Most of the potentially contaminated waste water originates from floor washing. The water is filtered and agitated prior to sampling, and then sent for independent analysis at an accredited external laboratory. The minimum detectable concentration is 0.000002 mg U/L (parts per million (ppm)).

After the waste water sample result is verified to be below the Internal Control Level of 3 ppm and the Action Level of 6 ppm (per batch), the wash water is discharged to the sanitary sewer.

The ten-year trend graph of uranium water releases, presented in Figure 18, shows a stable performance consisting of very low uranium in water concentrations. The sample batch number size is limited and trending is difficult due to small random fluctuations in low concentrations. Water release results continue to remain low and below the Action Levels of 6 ppm (per batch) and 3 ppm (annual average). The total release of 0.21 g is a very small fraction of the derived release limit and of the regulatory discharge limit of 760 kg/year.

A second liquid effluent from the Peterborough facility is beryllium in water that is generated from equipment use and cleaning activities. BWXT NEC has established an Internal Control Level of 4 µg/L and the Action Level is 40 µg/L. The Internal Control Level is conservatively consistent with international drinking water guidelines for beryllium, noting that the discharge point is to the sanitary sewer (i.e. not to drinking water). All potentially beryllium contaminated water passes through a weir

settling system prior to release to the sanitary sewer. Regular sampling of the beryllium wastewater is conducted. The water sample consists of a 24-hour composite sample taken from the outflow lines. It is sent for analysis at an external accredited independent laboratory. The minimum detectable concentration is 0.007 µg Be/L (0.000007 mg Be/L or parts per million (ppm)).

Beryllium average and maximum concentrations and Internal Control Level exceedances are trending down overall following the replacement of the weir settling system in December 2015, as presented in Figure 19. Where Internal Control Levels are exceeded, internal investigation is conducted to determine the cause and corrective/preventive actions are tracked to closure. The small increase in the amount of liquid discharged resulted from a change to the floor washing protocols and increased non-routine work in the R2 area related to the installation of the pellet sort and stack operation.

	Peterborough				
	2016	**2017**	**2018**	**2019**	**2020**
Total Amount of Liquid Discharged (L) from Uranium Processing Areas	820	820	820	615	1025
Maximum Uranium Concentration (at the point of release) (ppm)	0.48	0.09	0.03	0.07	0.37
Average Uranium Concentration (at the point of release) (ppm)	0.15	0.04	0.02	0.04	0.20
Number of Samples Exceeding Action Level (6 ppm per batch)	0	0	0	0	0
Total Uranium Discharge to Sewer (g)	0.13	0.03*	0.01	0.02	0.21
Total Number of Samples Analyzed for Beryllium Concentration in Water	18	17	19	19	20
Maximum Beryllium Concentration (at the point of release) (µg/L)	2.5	5.4	2.5	1.8	9.1
Average Beryllium Concentration (at the point of release) (µg/L)	0.4	1.0	0.6	0.6	1.4
Number of Samples Exceeding Internal Control Level (4 µg/L)	0	2	0	0	1
Number of Samples Exceeding Action Level (40 µg/L)	N/A	N/A	0	0	0

Table 41: Peterborough Water Effluent Monitoring Results

*Value revised from original report.

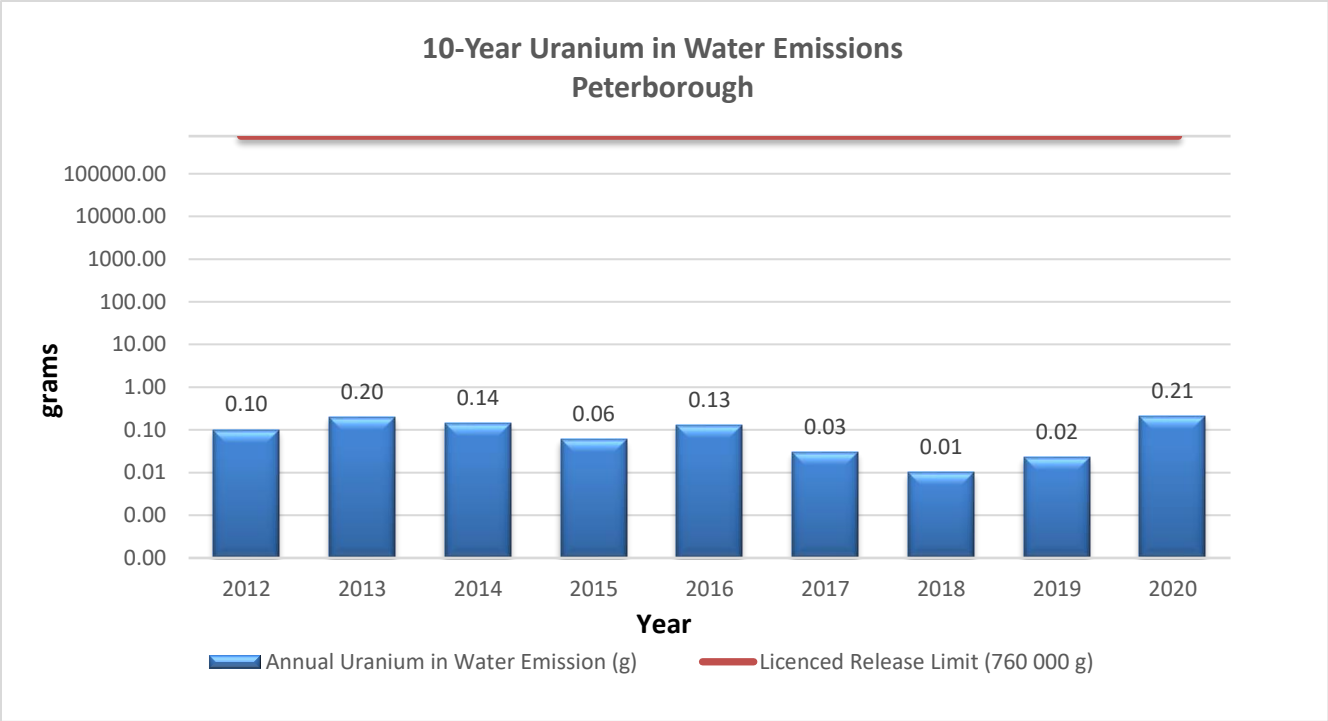

Figure 18: Peterborough 10-Year Uranium in Water Emissions

Note: The above graph has a logarithmic scale.

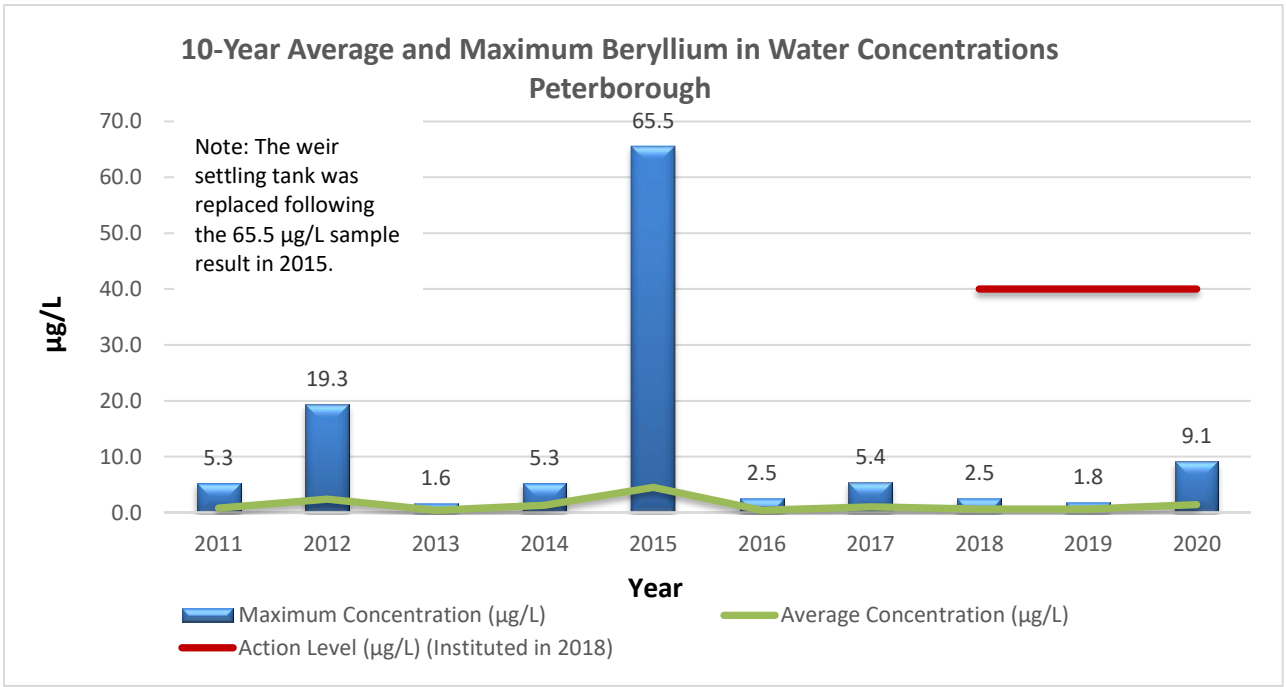

Figure 19: Peterborough 10-Year Beryllium in Water Concentrations

3.9.7.2 Toronto Water Monitoring

In Toronto, water is used to clean protective clothing, walls, floors, equipment and in various other janitorial functions. The water is treated to remove UO_2 and the concentration of UO_2 in waste water leaving the treatment system is measured in-house. The concentration of UO_2 in the total waste water leaving the plant premises is calculated and compared to the Internal Control Level of 3 ppm and the Action Level of 6 ppm (per batch). Maximum values reported are calculated from the analyzed in-house samples. In addition, a weekly composite sample is prepared and sent for independent analysis at an accredited external laboratory. The minimum detectable concentration is 0.000001 mg U/L or parts per million (ppm). Averages and annual releases are calculated from the weekly composite samples.

The water effluent treatment system at the Toronto facility operates as follows:

1. Waste water is held in batches
2. Each batch is treated, then sampled
3. Each batch is only released when in-house sample results confirm the concentration is less than 3 ppm (note: The Action Level for a batch is 6 ppm)

Results from water effluent monitoring are summarized in Table 42. Sample measurements are taken at the point of release, prior to mixing with non-process water. Annual discharges for uranium in Toronto are trended in Figure 20. Toronto total liquid effluent releases are showing a downward trend. Decreased average uranium concentration at the point of release is attributed to changes in chemical usage for water treatment. Results continue to remain low and below the Action Levels of 6 ppm (per batch) and 3 ppm (annual average). The total release of 0.36 kg during the reporting period is well below the licensed release limit of 9000 kg/year.

Early in 2021 it was identified that BWXT was incorrectly applying the less restrictive sewer use bylaw values for pH (acidity/alkalinity) instead of the slightly more restrictive CNSC Action Levels. As a result, 27 instances of exceedances of the lower pH Action Level were identified. This was reported to the CNSC in accordance with reporting requirements, and an investigation initiated. It is noted that all releases met the sewer use bylaw requirements for pH.

	Toronto				
	2016	**2017**	**2018**	**2019**	**2020**
Total Amount of Liquid Discharged (L) (from Uranium Processing Areas)	1,239,375	1,140,225	1,295,560	1,232,765	1,493,860
Maximum Uranium Concentration (at the point of release) (ppm)	2.80*	2.56	2.95	2.58	2.79
Average Uranium Concentration (at the point of release) (ppm)	0.81*	1.12	0.72*	0.46	0.24
Number of Samples Exceeding Action Level (6 ppm per batch)	0	0	0	0	0
Total Uranium Discharge to Sewer (g)	650	941	935	572	357
Minimum pH	6.7	6.6*	7.1	6.5	6.0

	Toronto				
	2016	2017	2018	2019	2020
Average pH	7.1	7.2	7.6	7.6	7.2
Maximum pH	7.7	7.8	8.7	8.5	8.6

Table 42: Toronto Liquid Effluent Monitoring Results

* Value revised from original report.

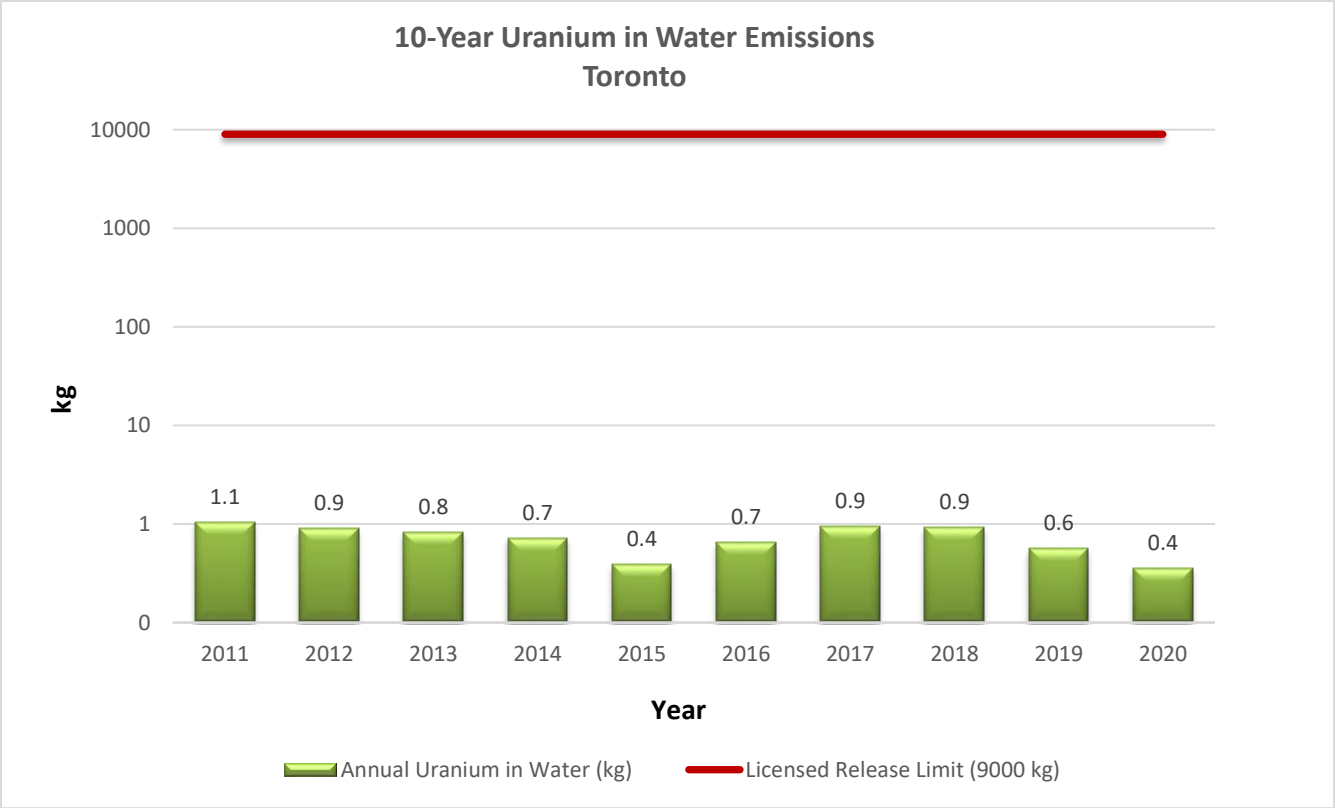

Figure 20: Toronto 10-Year Uranium in Water Emissions

Note: the above graph has a logarithmic scale

3.9.8 Soil Sampling Measurements/Monitoring

3.9.8.1 Uranium

Uranium may be detected at low levels in various rocks, ores, soil, water, air and plants. In Ontario, background levels of uranium in soil are generally below 2.5 µg/g ((parts per million (ppm)). The Canadian Council of Ministers of the Environment (CCME) have established soil quality guidelines to protect human health and the natural environment. The guidelines represent levels of uranium in soil below which no risk to human health is expected. For residential and parkland land use, the guideline is 23 µg/g; for commercial land use, the guideline is 33 µg/g; for industrial land use the guideline is 300 µg/g. These guidelines have been adopted by the MECP and are listed in Ontario Regulation 153/04. Uranium content in soil at concentrations higher than the MECP standards suggest a need for further assessment, and mitigation of the source of the uranium to eliminate potential exposure and environmental impairment.

Depositions of uranium are measured by taking small samples of surface soil and analyzing for natural uranium. Uranium in soil sampling is not conducted at the Peterborough facility due to the negligible air release measurements. Uranium in soil sampling is conducted annually at the Toronto facility by a third-party consultant. If soil analysis indicates rising natural uranium levels, emissions may have increased and investigation is made into the cause.

Facility UO_2 air emissions are the primary pathway for potential release into the natural environment by impingement on the ground surface in the immediate vicinity of the facility depending on the wind direction. UO_2 is insoluble in water but may be washed into the soil by rainfall, snow, etc. Surface uranium levels will indicate deposited emissions. Continuous ambient air monitoring units are installed at the perimeter of the facility (boundary air monitors) to verify the effectiveness of the emission control systems. No concerns have been detected regarding release of uranium as sampled at the perimeter/boundary air monitoring units which is consistent with very low emissions as measured at the emission stacks.

At the Toronto facility, samples of surface soil are retrieved from 49 locations in accordance with a documented plan. The sampling methodology used is based on the MECP “Guidelines on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario,” December 1996, ISBN-0-7778-4056-1. Annually, the five-year average wind data obtained from Toronto Pearson Airport climate data centre (located approximately 12 kilometers west of the facility), is reviewed and used to confirm the appropriateness of the selected soil sampling locations. The data shows prevalent winds from north to south-west blowing across the BWXT NEC location. Three quality control soil samples at a background location more than 20 km north and east of the facility are also taken, along with two replicate soils samples for field quality control purposes. The soil samples are stored in a cooler with ice and transported the next day for analysis at an independent accredited laboratory by Inductively Coupled Plasma Mass Spectrometry for uranium content. The minimum detectable concentration is 1.0 part per million (1.0 µg U/g). Results are compared to previous years and the CCME guidelines. A summary of results taken in the reporting period is listed in Table 43.

	Location Description		
	On BWXT NEC property	**On industrial/commercial lands, i.e. south rail lands**	**All other locations, i.e. residential**
Relevant CCME Guideline (µg U/g)	**300 µg U/g**	**33 µg U/g**	**23 µg U/g**
Number of Samples Taken	1	34	14
Average concentration (µg U/g)	1.3	2.9	1.0
Maximum concentration (µg U/g)	1.3	17.6	1.0

Table 43: Toronto Soil Sampling Result Summary

The analytical results for uranium concentrations for all soil samples analyzed are without exception well below the acceptable standard published by the MECP under Ontario Regulation 153/04 and CCME soil quality guideline. The results show a range of concentrations from <1.0 µg/g to 17.6 µg/g with 34 sample locations having reported uranium concentrations below the Ontario background concentration of 2.5 µg/g.

It is noted that uranium content in 2020 has remained generally within the historical concentrations recorded. The reported analytical results for uranium concentrations in 2020 show an increase at 22 of 49 sample locations, decrease at 11 locations and 16 locations remained the same. The results are generally consistent to historical results reported by the former GE Hitachi (now BWXT NEC), MECP and the Canadian Nuclear Safety Commission for soil samples collected during previous annual sampling events. The environmental risk associated with the presence of detectable concentrations of uranium in soil is considered very low.

3.9.8.2 Beryllium

Beryllium is a naturally occurring stable element that is present in a variety of materials including rocks, coal and oil. It can also be found commercially in everything from cell phones and airbag sensors to aircrafts and pacemakers. Beryllium can be hazardous if its use is not properly controlled. It is used in small amounts at BWXT NEC's Peterborough operations to join portions of the fuel bundle together.

Soil sampling was conducted in 2020 around the Peterborough facility as committed in the CNSC licence renewal hearing in early 2020. Soil sampling is not conducted at the Toronto facility as beryllium is not used. Facility beryllium air emissions are the primary pathway for potential release into the natural environment by impingement on the ground surface in the immediate vicinity of the facility depending on the wind direction. Depositions of beryllium are measured by taking small composite samples of surface soil and analyzing for beryllium.

Soil samples were obtained by a third-party consultant from twenty-one samples. Locations were selected for consistency with the CNSC's IEMP. The sampling methodology used is based on the MECP "Guidelines on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario," December 1996, ISBN-0-7778-4056-1. All analytical protocols followed O. Reg. 153/04 (as amended)

document entitled “Protocol for Analytical Methods Used in the Assessment of Properties Under Part XV.1 of the Environmental Protection Act”. Three quality control soil samples were collected from a background location approximately 19 km west of the facility, along with two replicate soil samples for field quality control purposes. The soil samples are stored in a cooler with ice and transported the next day for analysis at two independent accredited laboratories by Inductively Coupled Plasma Mass Spectrometry for beryllium content. The minimum detectable concentration is 0.5 part per million (0.5 µg Be/g). Results are compared to the MECP standard and CCME guidelines. A summary of results taken in the reporting period is listed in Table 44.

	Location Description
	On institutional or park lands
Relevant MECP Guideline (µg Be/g)	**2.5 µg Be/g**
Number of Samples Taken	21
Average concentration (µg Be/g)	0.50
Maximum concentration (µg Be/g)	0.52

Table 44: Peterborough Soil Sampling Result Summary

The analytical results for beryllium concentrations for all soil samples analyzed, without exception are well below the most stringent criteria published by the MECP under Ontario Regulation 153/04. All but two of 21 samples submitted were non-detect with results below the laboratory reported detection limit (<0.5 µg/g). One sample was detected at the laboratory reportable detection limit of 0.50 µg/g and one sample had a detection marginally above the laboratory reportable detection limit with a concentration of 0.52 µg/g. All results, without exception are well below the most stringent Ontario typical background concentration of 2.5 µg/g and the CCME guidelines for the protection of environmental health (4 mg/kg) and human health (75 mg/kg).

3.10 Emergency Management and Fire Protection

The emergency preparedness and fire protection programs are well-established and effective. Each facility has established emergency response plans that describe the actions to be taken to minimize the health and environmental hazards, which may result from fires, explosions, or the release of hazardous materials. The plans include effects to the local area and members of the public. The plans are intended to reduce the risk of fires within the facility and assist emergency staff and plant personnel in understanding key emergency response issues, and assist the facility in protecting employees, the local community and the environment through sound emergency management practices. The emergency response plans are developed in accordance with standards and meets the CNSC operating licence requirements.

Continuous improvement is achieved through several review processes, including site inspections, reported safety concerns, near miss and incident investigations, drills and self-assessments. Non-conformances are tracked to closure.

There were no events that activated the emergency organizations during the reporting period. In Toronto, there were two events that required portions of the emergency plan to be implemented. In the first, in-house emergency responders followed decontamination and injury protocols while responding to a medical incident requiring an ambulance. In the second, response procedures related to a hydrogen alarm occurred following calibration work that triggered a hydrogen alarm.

3.10.1 Emergency Preparedness Program Activities

The Peterborough site developed and implemented its revised Emergency Response Program. Program improvements included the redistribution of roles and responsibilities, better definition of the command and control structure, and the development of detailed work instructions for response. Designated Emergency Operations Centre locations were established and equipped with the tools and technology required to respond to an emergency event. Peterborough Fire Services participated in joint emergency exercises throughout the year. The CNSC conducted an emergency preparedness inspection at the Peterborough facility where the improved emergency response program was exercised successfully.

The Toronto site continued with program improvements, which focused on cross training and drill management. There were a number of improvements recommended as a result of drills in the areas of emergency equipment, communication, and emergency procedures.

Emergency preparedness training is achieved through response drills where actual responses are regularly critiqued to continually improve the effectiveness of the process. These are conducted at least annually. All employees are trained on established fire prevention measures, emergency situation responses, emergency evacuation routes and their responsibilities. Awareness training is conducted during new employee orientation and refreshed through response drills. On-site emergency responders are provided with the level of training necessary to allow them to effectively perform their designated functions as defined in each facilities training matrix. Training course completion is summarized in Table 4.

Tests of the emergency response plans were performed in the following areas:

At the Peterborough site:

1. Fire safety/Evacuation (five)
2. Spill (one)
3. Medical (one)

Peterborough Fire Services participated in four of these drills, while Peterborough Paramedics participated in one drill. A full-scale emergency exercise occurred and was witnessed by the CNSC as part of an inspection. Inspection details are provided in section 3.1.2.

At the Toronto site:

1. Fire safety/evacuation (two)
2. Emergency plan (one)
3. Hydrogen alarm (one)
4. Medical emergency (one)

3.10.2 Fire Protection Program Activities

The Fire Protection program describes the systems and resources available to prevent and detect fire and to minimize impact from a fire event and consist of the following key elements:

Fire and Life Safety Features;

- Inspection and Maintenance;
- Fire Protection Assessment;
- Fire Protection;
- Housekeeping;
- Minimization of Combustibles;
- Ignition Source Control;
- Impairment;
- Design for the Prevention and Mitigation of Fires;
- Training;
- Outside Coordination; and
- Program Assessment.

The documented fire hazards analysis (FHA) identifies the facility fire hazards and their potential impact on the worker and public safety and asset protection. In Peterborough, FHA's for building 21, building 24, and buildings 26/28 were updated and submitted to the CNSC and meet the required standards.

The facilities maintain documented fire safety plans that are developed in accordance with the National Fire Code of Canada, the National Building Code of Canada and CSA N393-13, *Fire protection for facilities that process, handle, or store nuclear substances*. The fire safety plans are based on the documented FHA and ensures that measures are appropriate to the facility. They provide information on resources in the buildings, emergency procedures and actions to be taken in the event of a fire. They include training, duties of designated personnel, details of maintenance procedures and fire protection measures. The information assists the occupants in utilizing life safety features in the buildings, ensure an orderly evacuation at the time of an emergency and provide a maximum degree of flexibility to achieve the necessary fire safety for the buildings.

Fire protection systems are inspected and tested in accordance with the National Fire Code of Canada following an established schedule. A third-party review and internal self-assessment is conducted annually at each site. Identified continuous improvements are tracked to completion using the ATS. During the reporting year, Toronto and Peterborough completed a Fire Protection Program audit as per CSA N393-13 in addition to the above third party reviews and self-assessments.

During the reporting period, BWXT NEC's work with Peterborough and Toronto Fire Services, to establish a clear basis for contingency response planning between the organizations to deal with fire and rescue emergency situations at BWXT NEC, was limited as a result of the pandemic. The program facilitates effective communication and exchange of relevant information, and assures timely, reliable, and effective decision making and response actions. Site hazard reviews and site familiarization tours are scheduled annually with Peterborough Fire Services and Toronto Fire Services. Unfortunately, the site familiarization tours were not able to take place due to pandemic restrictions. These tours are planned for 2021.

In Toronto, a review of Fire and Life Safety System Impairment procedures was completed. The National Fire Code and *CSA N393-13, Fire Protection for Facilities that Process, Handle, or Store Nuclear Substances* were reviewed for impairment procedure requirements against existing documentation and a stand alone document was created.

Physical plant changes are periodically made to improve fire protection programs. In Toronto, minor changes to improve the fire protection program were completed including the repair of damaged fire separations (i.e. fire stopping holes and ceiling tile replacement), and the updating of some aging emergency lighting units. In Peterborough, the Building 24 underground sprinkler main was replaced by the facility landlord.

3.11 Waste Management

The "Waste Management" Safety and Control Area covers internal waste and by-product related programs which form part of the facility's operations, up to the point where the waste is removed from the facility to a separate waste and by-product management facility. This Safety and Control Area also covers the ongoing decontamination and planning for decommissioning activities.

Radioactive wastes are any materials that contain a nuclear substance, and which have been declared to be waste. BWXT NEC has an effective and well-established radioactive waste disposal program that ensures all radioactive waste disposals are compliant with the Nuclear Safety and Control Act and associated regulations and the facility operating licence conditions. Radioactive solid waste generated from fuel manufacturing, which consist of, or are contaminated by uranium are accumulated in controlled and classified areas. A low volume of radioactive wastes from Peterborough are transported to and consolidated with the Toronto facility wastes. These are combined, compacted for volume reduction where possible, and shipped routinely to a licensed radioactive waste disposal facility. In Toronto, only about 0.1% of the uranium that is processed ends up in waste streams. Nearly all nuclear material is used in the product or recycled back to the supplier.

Waste management and generation details are further described in Appendix B, submitted to the CNSC separately.

BWXT NEC maintains preliminary decommissioning plans (PDPs) and financial guarantees for both the Toronto and Peterborough facilities in accordance with CNSC Regulatory Guide G-219 Decommissioning Planning for Licensed Activities, CNSC Regulatory Guide G-206 Financial Guarantees for the Decommissioning of Licensed Activities, and CSA N294-09 Decommissioning of Facilities Containing Nuclear Substances. The PDP strategy and end-state objective of decommissioning is to release the site from regulatory control for industrial use or demolition of the structures. These are reviewed at least once every five years. No changes were made to the PDPs during the reporting period.

The Peterborough site conducts an annual Waste Audit and Waste Reduction Work Plan due to the large office space, in accordance with Ontario Regulation 102/94 under the Environmental Protection Act. This audit is not required at the Toronto facility. The audit serves to assess and advance the non-nuclear waste diversion initiatives and consists of the physical collection and sorting of generated waste and includes a waste composition study. It provides a prepared Waste Reduction Work Plan where areas of success are highlighted and opportunities for improvement are identified through waste reduction, reuse and recycling. The results of the audit are communicated to employees and waste reduction and diversion initiatives are undertaken.

3.12 Security

The "Security" Safety and Control Area covers the programs required to implement and support the security requirements stipulated in the regulations and in the operating licence.

The Toronto and Peterborough facilities each maintain a security program in accordance with the General Nuclear Safety and Control Regulations, Class I Nuclear Facilities Regulations, and the Nuclear Security Regulations. The security programs outline the systems, processes and responsibilities for performing security operations with the objective of maintaining safe and secure facilities. The program manuals identify the individual responsibilities for implementation and maintenance of the program. The manuals

include instructions for administering the security program, provides the basis for security protocols and identifies the controls in place to meet regulatory requirements. Program details are prescribed information and confidential. Examples of security measures in place at both facilities include:

- Access control (access cards and locked restricted-access areas);
- Facility Access Security Clearance program;
- Security guards;
- Security barriers;
- Intrusion detection systems; and
- Preventing the unauthorized removal of nuclear material.

3.13 Safeguards and Non-Proliferation

The "Safeguards and Non-proliferation" Safety and Control Area covers the programs required for the successful implementation of the obligations arising from the Canada/IAEA Safeguards and Non-proliferation Agreement. BWXT NEC has implemented and maintains a safeguards program and undertakes all required measures to ensure safeguards implementation in accordance with IAEA commitments and CNSC regulatory document 2.13.1 *Safeguards and Nuclear Material Accountancy (which superseded RD-336 Accounting and Reporting of Nuclear Material)*. Movement of safeguarded nuclear material (inventory changes) are documented and reported to the CNSC as required.

BWXT NEC has implemented and maintained a well-established Safeguards program throughout the licence period and undertakes all required measures to ensure IAEA commitments and CNSC regulatory requirements are met. BWXT NEC reports all Inventory Change Documents for both facilities through the Nuclear Materials Accountancy Reporting system.

In Peterborough, the Physical Inventory Taking, was conducted on July 21st. Physical Inventory Verification and Design Information Verification involving the CNSC and the IAEA followed on July 22nd, 2020. The scope of the Physical Inventory Verification concerned book examination, physical verification of nuclear material and evaluation of the quality and performance of BWXT NEC Inc.'s measurement system. The scope of the Design Information Verification concerned verification of the facility, general building design, essential equipment, accounting procedures, operator's measurement system, nuclear material characteristics, nuclear material location & flow and operational status of the facility. Short Notice Random Inspections were conducted by the IAEA on March 12th, May 20th and 21st and November 18th, 2020. The inspection involved physical examination of bundle boxes, sampling and scanning of pellet skids and verification of records. No non-conformances were noted.

In Toronto, the Physical Inventory Taking was conducted on July 20th. A Physical Inventory Verification and Design Information Verification involving the IAEA followed on July 24th 2020. The scope of the Physical Inventory Verification concerned book examination, physical verification of nuclear material and evaluation of the quality and performance of BWXT NEC Inc.'s measurement system. The scope of the Design Information Verification concerned verification of the facility, general building design, essential equipment, accounting procedures, operator's measurement system, nuclear material characteristics, nuclear material location & flow and operational status of the facility. Short Notice Random Inspections were conducted by the IAEA on February 6th and 7th and October 21st and 22nd, 2020. The inspection involved sampling, measurements and verification of records. No non-conformances were noted.

3.14 Packaging and Transport of Nuclear Substances

The "Packaging and Transport of Nuclear Substances" Safety and Control Area covers the packaging and transport of nuclear substances and other nuclear materials to and from the licensed facilities. In the reporting period, all packaging and shipments to and from both facilities were conducted safely according to applicable regulations. Shipments of dangerous goods are not routinely made from BWXT NEC by air, rail or water. Routine road shipments of both dangerous goods and non dangerous goods are made between suppliers, the Toronto plant, and the Peterborough plant and customer nuclear generating stations. Shipments of prescribed substances are only made to:

- Persons in Canada, holding a valid CNSC Licence to possess such prescribed substances; or
- Persons in Canada, not requiring a valid CNSC Licence by virtue of the Nuclear Safety and Control Act and regulations; or
- Persons outside Canada, as approved by an Export Permit, CNSC Export Licence, or combination of CNSC Export Licence and reference to General Export Permit as applicable.

The transportation of dangerous goods in Canada is regulated by Transport Canada through the Transportation of Dangerous Goods Regulations. Additional requirements for the transport of Class 7 radioactive materials is regulated by the CNSC through the Packaging and Transportation of Nuclear Substances Regulations. In addition, the IAEA has established uniform regulations for all modes of transportation throughout the world. The IAEA has published the Regulations for the Safe Transport of Radioactive Material and the CNSC has endorsed these through the Packaging and Transport of Nuclear Substances Regulations.

BWXT NEC has an established Emergency Response Assistance Plan compliant to Part 7 of the Transportation of Dangerous Goods Regulations. During the reporting period, the plan was revised and approved by Transport Canada. It is in place to ensure that timely and effective response protocols are in place with the intent to protect public safety, property and the environment in the event of an accident involving the transportation of natural or depleted UO_2. Transportation of uranium materials to and from BWXT NEC are included in the plan.

4 OTHER MATTERS OF REGULATORY INTEREST

4.1 Public Information Program

Employee/Internal Communications

BWXT NEC uses a variety of means to engage its ~450 employees in Peterborough, Toronto and Arnprior. The company uses the employee portal (intranet), electronic bulletin boards, email alerts and printed communications to issue company news, executive blogs and general business updates.

The president of BWXT NEC normally holds all-employee meetings at all sites in the fourth quarter of the year. Due to the COVID-19 pandemic, this meeting was recorded and shared with employees virtually. Open communication is important to the president of BWXT NEC and he encourages employees contact him throughout the year with questions.

Government Stakeholders

BWXT NEC places great importance on its relationships with all levels of government in the communities in which it operates and works to ensure there is open communication and awareness of BWXT NEC's operating activities.

In 2020, BWXT NEC emailed several electronic updates to the MP for Peterborough-Kawartha, MPP for Peterborough, MP and MPP for Davenport, Mayor and Councillors for Peterborough and Councillor for

Davenport. These communications provided elected officials in Toronto and Peterborough with information about the licence renewal, invitations for tours, meetings and virtual community events, relevant information and links, and copies of newsletters and other documentation. In 2020, no facility tours were conducted with elected officials due to the pandemic. Virtual meetings were held with the MP for Davenport's office, MPP for Davenport, and the Councillor for Davenport's office. BWXT NEC also responded to letters from the MP of Davenport and the MP for Peterborough-Kawartha. The MPP for Peterborough-Kawartha participated as a guest speaker during a media event BWXT NEC held at its Peterborough facility with Ontario Power Generation and Laurentis Energy Partners to highlight progress made in the production of a life-saving medical isotope.

Indigenous Relations

BWXT Canada (which includes BWXT NEC) has been a member of the Canadian Council of Aboriginal Business (CCAB) since September of 2017 and is currently Progressive Aboriginal Certified (PAR) at the committed level. This signifies BWXT Canada's commitment to continual improvement in Indigenous relations and intention to undergo external verification of performance in the future.

BWXT Canada's Indigenous Relations Committee meets regularly to review objectives outlined in the PAR criteria as the company works to find ways to strengthen its ties with Indigenous communities.

In 2020, BWXT NEC contacted its local Indigenous communities via letter and/or email (depending on preference). These communications provided information about the licence renewal, invitations for tours, virtual meetings and community events, relevant information and links, and copies of newsletters and other documentation.

In 2020, BWXT NEC met with Curve Lake First Nation three times (once in person and two meetings were held virtually).

The company is also an active member within the Indigenous Relations Suppliers Network established by Bruce Power and Indigenous Opportunities in Nuclear program established by Ontario Power Generation. In November, BWXT NEC sponsored the Métis Nation of Ontario's Annual General Assembly.

Overall, the CCAB PAR program supports BWXT NEC's commitment to engaging with Indigenous communities and working together to build and sustain meaningful long-term relationships. More information on BWXT NEC's commitment to Indigenous relations, including our policy, can be found at www.nec.bwxt.com under the Community tab.

Community Relations

BWXT NEC is committed to providing information to the communities in which it operates and works to ensure there is open two-way communication and awareness of BWXT NEC's operating activities.

Throughout 2020, BWXT NEC utilized a variety of communication channels to provide information to its neighbours, including electronic email updates to its contact list (which includes interested members of the public), outdoor screens throughout Peterborough, banners along the fence line, newsletters, mailers, social media, Facebook targeted advertising and through phone and web surveys.

Community members can sign up to join BWXT NEC's email updates anytime by contacting the company at questions@bwxt.com.

Community Volunteerism

With the COVID-19 pandemic pausing in-person volunteering events, BWXT NEC's employees remained committed to supporting their community through charitable giving. In 2020, Peterborough employees contributed to a spring fundraiser for Kawartha Food Share, an Angel Tree collection for Kinark Children's Services and some employees participated in a charitable parking program which provides donations to Peterborough Regional Health Centre (PRHC) Foundation.

Community Investment

In Peterborough, BWXT NEC made charitable contributions to Big Brothers Big Sisters, Kinark Child & Family Services, Métis Nation of Ontario, Fleming College, Kenner Collegiate, Adam Scott Collegiate and Vocational Institute, Kenner Collegiate Vocational Institute, Crestwood Secondary School, Five Counties Children's Centre, Peterborough Regional Science Fair, United Way, Peterborough Regional Health Centre (PRHC) Foundation, Dragon Boat, and the Community Counselling Resource Centre.

In Toronto, BWXT NEC made charitable contributions to the Toronto District School Board's Western Technical Commercial School for both their FIRST Robotics Program as well as a bursary award. BWXT NEC also made charitable contributions to the Davenport-Perth Neighbourhood and Community Health Centre, Ontario Tech University, and Pauline Junior Public School.

In Arnprior, BWXT NEC made charitable contributions to Arnprior District High School for both their FIRST Robotics team as well as a bursary award. BWXT NEC also made charitable contributions to the Arnprior Food Bank, Hospice Renfrew and the Child Poverty Action Network.

BWXT NEC also donated hand sanitizer and other supplies to local organizations to assist with the COVID-19 pandemic.

Tours

BWXT NEC provides facility tours to help engage members of the industry, local elected officials, Indigenous communities and interested members of the public in an effort to help better understand our business. In 2020, BWXT NEC provided facility tours in Peterborough to the following groups: Lake Ontario Waterkeeper/Swim Drink Fish Canada, North American Young Generation in Nuclear, Ontario Tech University, and Women in Nuclear Canada. In addition, BWXT NEC provided facility tours in Toronto to the following groups: Canadian Nuclear Workers Council, Ontario Tech University, and Peterborough Public Health.

BWXT NEC offered tours to its local elected officials in Peterborough and Toronto in early 2020 before the pandemic. BWXT NEC will continue outreach to elected officials.

Community Events

Due to the COVID-19 pandemic, BWXT NEC chose to cancel its annual in-person community barbeques in Toronto and Peterborough. Virtual Facebook Live events were held in lieu of the barbeques. The Peterborough Facebook Live was held on October 27, 2020 and the Toronto Facebook Live was held on October 26, 2020.

These virtual events provided a means to engage neighbours, community members and other stakeholders, and to educate them about our business. At the time of this submission, both events have had over 160 views.

Both virtual events were staffed by BWXT NEC leadership. An informative slideshow was presented where BWXT NEC representatives shared information about the company, safety and compliance, public information program, licence renewal, and facts about natural uranium. Throughout both virtual events, viewers could submit their questions in the comment section and BWXT NEC would address these questions live in the videos.

BWXT NEC included invitations to the Facebook Live events in newsletters, on its dedicated website, on social media and additionally used targeted Facebook advertising to share the invitation details.

Community Newsletters

BWXT NEC distributes, and posts to its website, community newsletters as a tool to share information with its local communities about the company's operational performance, health and safety, licence renewal, activities in the community and general information.

Three newsletters were issued to both the Toronto and Peterborough surrounding communities in May, September and November of 2020. The newsletters were also posted to our public information website, emailed to our contact list and shared on social media (once dedicated social media channels were established). Toronto newsletters are additionally translated to Portuguese on the website. In Peterborough, distribution increased to ~5,000 residents around the facility and in Toronto, distribution increased to ~6,500 residents around the facility. After receiving feedback from the March, 2020 licence renewal hearing, BWXT NEC overhauled its Community Newsletter format to include more information about safety at the facility and how the company protects the environment, as well as easy-to-digest information about how the company controls its exceptionally low emissions.

Community Liaison Committee - Toronto

The Toronto CLC was established in 2013 and meets three-four times per year. In 2020, all meetings were held virtually due to the pandemic (normally meetings are held in-person at the Toronto BWXT NEC facility in the evenings). The CLC is a forum for the exchange of information between the community and BWXT NEC and allows members to bring forward questions, discuss concerns and identify opportunities to improve community relations.

BWXT NEC held a new member orientation on March 24th and met with the CLC on April 15th, June 16th, September 22nd and held a year-end meeting on November 17th of 2020. A makeup orientation session was also held for members who missed the initial meeting on June 10th. Meeting records are posted to the company's website.

In 2020, CLC members virtually met with BWXT NEC staff to discuss the facility's operations and received updates on topics such as the licence renewal hearing, Annual Compliance Report, CNSC Independent Environmental Monitoring Program (IEMP), Regulatory Oversight Report, community surveying, public concerns, media coverage, community giving, emergency preparedness and safety scenarios, environmental monitoring, public information program updates, community initiatives and events, and more.

Two representatives from the CNSC attended the June CLC meeting in 2020 as guests. Additionally, at the request of the CLC, a guest speaker from BWXT's nuclear medicine division attended the September meeting in 2020 to provide an overview of nuclear medicine and BWXT's involvement.

In 2020, the CLC had a membership of seven external members (including a representative from an environmental non-government organization). BWXT NEC launched a recruitment campaign in the fall of 2020 to attract new members for which six applications were received. All six applicants (one of which is a

representative of a local first responder organization and another which is a representative of a local health organization) were accepted upon review and will join the committee in 2021.

Community Liaison Committee - Peterborough

The Peterborough CLC was established in 2020 and meets three-four times per year. In 2020, all meetings were held virtually due to the pandemic (normally meetings would have been held in-person at the Peterborough BWXT NEC facility in the evenings). The CLC is a forum for the exchange of information between the community and BWXT NEC and allows members to bring forward questions, discuss concerns and identify opportunities to improve community relations.

BWXT NEC began the CLC mid-way through 2020 as recruitment began early 2020. The company held a new member orientation on May 26th and met with the CLC on June 22nd and October 1st. BWXT NEC setup an impromptu meeting on November 10th and held a year-end meeting on November 26th of 2020. A makeup orientation session was also held for members who missed the initial meeting on June 10th. Meeting records are posted to the company's website.

In 2020, CLC members virtually met with BWXT NEC staff to discuss the facility's operations and received updates on topics such as the licence renewal hearing, Regulatory Oversight Report, community surveying, public concerns, media coverage, community giving, emergency preparedness and safety scenarios, environmental monitoring, public information program updates, community initiatives and events, and more. Two representatives from the CNSC attended the June CLC meeting in 2020 as guests.

In 2020, the CLC had a membership of four external members (including a representative a local health organization and a local school). BWXT NEC launched a recruitment campaign in the fall of 2020 to attract new members for which seven applications were received. Five of the seven applicants (one of which is a representative of a local Indigenous community and one is a representative of a local organization) were accepted upon review and will join the committee in 2021. The two applicants not accepted were not of age to participate on the CLC as per the Terms of Reference.

Website

BWXT NEC has a dedicated public information website, located at nec.bwxt.com.

The website provides information about the company's operations and activities that can be accessed by members of the public and other key stakeholders 24/7.

In 2020, there were 16,425 sessions from 12,153 users. Top pages visited were: Home page (29%), About Peterborough (9.7%), About (8.4%), Contact Us (6.5%), About Toronto (4.5%) and Licencing (3.5%).

2020 saw an increase of 22.9% in visitors compared to 2019.

Over the course of 2020, new information was regularly updated on the website. The following represents some of the updates that were posted:

- Licence renewal updates
- Document summaries and environmental information
- Frequently asked questions
- Peterborough and Toronto CLC (meeting minutes, recruitment)
- Copies of the Toronto (three) and Peterborough (three) newsletters
- Facebook Live information
- Annual Compliance Report information
- Notice of CNSC's annual public meeting

Information Brochures

BWXT NEC maintains public information brochures for the Peterborough and Toronto sites. These brochures are updated on a yearly basis when new information is available from the Annual Compliance Report. These brochures are available at both sites for use during tours and meetings and are also posted on our public website. Brochures are used as information tools at community events like job fairs and community barbeques.

Public Inquiries

Members of the public can contact BWXT NEC by dialing our toll-free number, 1.855.696.9588 and/or emailing us at questions@bwxt.com. These contact details appear on BWXT NEC's website and in community newsletters and public information brochures.

In 2020, 1,112 emails were received by questions@bwxt.com, the majority of which were spam, solicitations, job seekers or agencies seeking employment verifications. BWXT NEC did notice an increase in questions from the public via emails during the beginning months of 2020. We encourage community members to use this outlet to contact us with questions, comments and concerns. In 2020, there were 117 calls to the 1.855.696.9588 toll free number, most of which were related to employment verification, community giving or public/media relations.

All emails and calls to the information line were appropriately handled and addressed.

Earned Media

BWXT NEC was mentioned in over 80 Peterborough news articles and a few Toronto news articles; many of which were opinion editorials from Peterborough citizens regarding the licence renewal. Overall, majority of media coverage in 2020 was neutral or negative reflecting concerns from community members on BWXT NEC's licence renewal, pelleting in Peterborough, CNSC's IEMP, beryllium sampling and coverage, and the CNSC public hearing. BWXT NEC received positive coverage around an event held in September related to its work to support BWXT's medical isotope business.

Social Media

In October of 2020, BWXT NEC launched its own dedicated Facebook and Twitter social media platforms to better engage with its community members. Before launching, BWXT NEC leveraged BWX Technologies' social media channels, which include Twitter, Linked-In and Facebook. Social media channels help BWXT NEC share information about activities with the public in a timely way. In 2020, BWXT NEC issued 14 social media posts on BWX Technologies platforms. Once BWXT NEC launched its own dedicated channels in October of 2020, the company began posting approximately 3-5 times per week. Post topics include invitations to events, information about the public hearing, job postings, community giving and involvement information, CLC recruitment, educational information, industry highlights, and more.

Public Disclosure Protocol

BWXT NEC has a Public Disclosure Protocol in place that sets guidelines to providing timely information to interested members of the public and other stakeholders. This Protocol and any Public Disclosures issued by BWXT NEC can be found at nec.bwxt.com under the Community tab. The Public Disclosure Protocol document is also available in full on the website as a PDF.

There was one public disclosure made in 2020 for a false sprinkler alarm at the Peterborough facility with no health or safety risk posed to the public, employees or the environment.

4.2 Cost Recovery

BWXT NEC is current on its cost recovery payments to the CNSC.

4.3 Financial Guarantees

PDPs and associated decommissioning cost estimates for both facilities are in place in accordance with CNSC Regulatory Guide G-206 Financial Guarantees for the Decommissioning of Licensed Activities, CNSC Regulatory Guide G-219 Decommissioning Planning for Licensed Activities, and CSA N294-09 Decommissioning of Facilities Containing Nuclear Substances. The PDP strategy and end-state objective of decommissioning is to release the site from regulatory control for industrial use or demolition of the structures.

On December 22nd, 2020 the CNSC in its relicensing decision accepted the proposed financial guarantee amounts and financial instruments which replaced the existing letter of credit in the first quarter of 2021.

4.4 Improvement Plans and Future Outlook

BWXT NEC remains committed to continuously improve its EHS programs to improve efficiency and minimize risk to employees, the public and the environment. Facility operations are projected to remain consistent in 2021. Fuel production levels are projected to be similar to the amount processed in 2020.

On December 22nd, 2020 the CNSC renewed BWXT NEC's operating licence as two separate licenses for Peterborough and Toronto with ten year terms ending in 2030. As requested in the BWXT NEC licence application, the amended licence for Peterborough includes fuel pellet production. Although this activity is now authorized under the licence, BWXT NEC has no plans to conduct pelleting in Peterborough at this time.

The following improvements are planned for the next year:

- Update elements of the Toronto Emergency Plan
- Conduct a full scale emergency exercise in Toronto
- Perform annual soil sampling for Beryllium and Uranium in Peterborough.

5 CONCLUDING REMARKS

BWXT NEC is committed to the establishment and continuous improvement of a healthy safety culture. Safety culture refers to the core values and behaviours resulting from a collective commitment by our company's leaders and individuals to emphasize safety, quality, ethics, and security over competing goals to ensure protection of employees, the public and the environment. It is a top business priority to continuously improve our EHS systems to protect fellow employees, the environment, and our communities against environmental, health and safety hazards. BWXT NEC management recognizes, reviews, prioritizes and controls workplace hazards and ensures compliance with applicable regulatory requirements, applicable codes and company policies.

Governed by an integrated management system, conventional health and safety, radiation protection and environmental protection programs are well implemented. All radiation dose measurement results were below Internal Control Levels, Action Levels and regulatory limits. Environmental protection programs are well implemented. There were no significant environmental issues or incidents encountered during the reporting period. Facility emission results were very low and below Internal Control Levels, Action Levels and regulatory limits with the exception of the exceedances of the pH Action Level for water in Toronto. Annual releases to the air and water were both a very small fraction of regulatory limits. Public dose for each facility was a small fraction of the public dose limit.

All production and possession limits were respected. Transportation of dangerous goods was conducted safely between suppliers, customers and waste vendors without risk to workers, the public or the environment.

This annual compliance monitoring and operational performance report demonstrates that BWXT NEC has successfully met the requirements of the Nuclear Safety and Control Act, regulations and CNSC Class IB Nuclear Fuel Facility Operating Licence requirements.